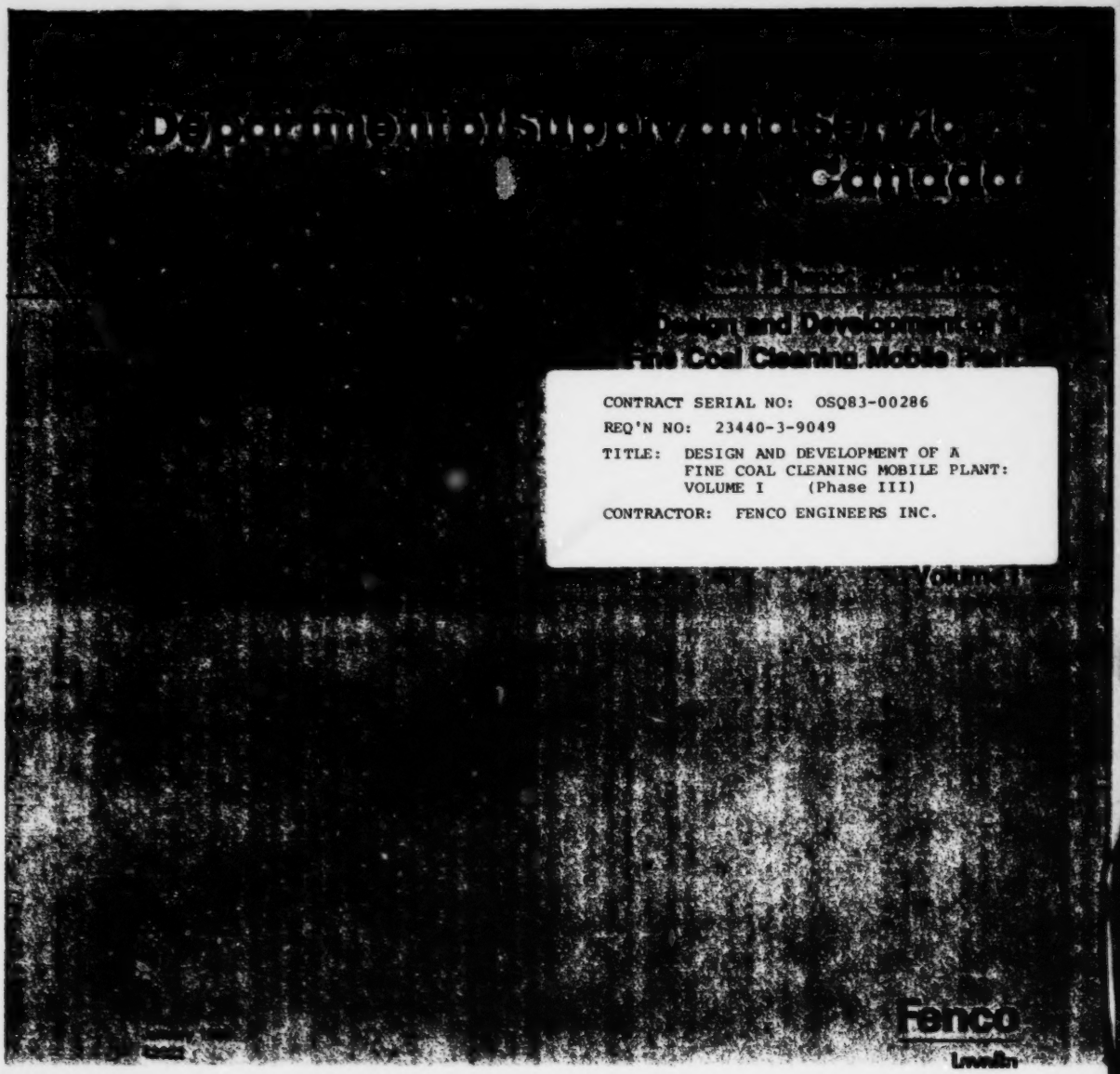
Volume

1



CONTRACT SERIAL NO: OSQ83-00286

REQ'N NO: 23440-3-9049

TITLE: DESIGN AND DEVELOPMENT OF A FINE COAL CLEANING MOBILE PLANT: VOLUME I (Phase III)

CONTRACTOR: FENCO ENGINEERS INC.

Fenco

MINERALS & METALS DIVISION
SUCCESSORS TO SIMON-CARVES OF CANADA LTD

FENCO ENGINEERS INC.
33 YONGE STREET, TORONTO
ONTARIO, CANADA M5E 1E7
TEL.: (416) 365-9955
TELEX: 06-23765
CABLE: LAVALIN TOR

February 27th, 1985

REQ. NO. 3-9049

CANMET
P. O. Bag 1280
Devon, Alberta
TOC 1E0

CONTRACT NO. 0SQ83-00286

Attention: Dr. Eng. Jozef Szymanski
Coal Research Laboratory

Dear Sir:

Re: Phase III Report - Detail Design
Design and Development of a Fine Coal Cleaning Mobile Plant

Accompanying this letter are 10 copies of the final report for this project. A copy of the cover sheet has been forwarded to Mr. Fresque at D.S.S.

Your letter of February 18, 1985 containing comments regarding the draft copy of the final report has been seriously considered and the points incorporated where necessary. These are discussed herein point by point.

1) Your suggestion concerning operating requirements is directly related to criteria associated with application of the mobile plant.

   This is an area which, of necessity, involves site specifics which cannot be covered in our report. The philosophy of employing mobile plants for test purposes belongs exclusively to CANMET and the merits of each application together with the criteria you require can only be judged from site specifics.

   We suggest that CANMET personnel are the only ones who can undertake the necessary review of such criteria on a case by case study of each application.

2. This point is not applicable. The frames and subframes are to be built to the dimensions given with standard fabrication tolerances.

3. The drawing title has been changed.

4) This is an excellent suggestion and has been adopted.

unable to count

..../2-

5) This statement is not applicable. No forced vibrations exist that warrant such an analysis. All loadings have been taken care of in our design.

6) Incorporated.

7) There will be no 575 volt motor on the mobile plant. The Sala pump will, in fact, be 2 hp 3/60/480 as shown on the motor list.

8) Piping will be Schedule 80 PVC.

9) We have included in the report logic diagrams Drawing Nos. 42022-I 18 through 25 which show the equipment sequence interlocks more clearly.

10) See 9).

11) The Central Control System specification consists of two major parts:

a) General requirements as described in Section 9.1.5.

b) Specific detailed requirements as described in Section 9.2.7.

It shall be recognized that, although the CCS will be functionally designed and constructed using standard control components, the physical design of the enclosure, the mounting of items, etc. is special and unique to the Mobile Unit.

Based on discussions with a number of suppliers, it is apparent that each one of them would approach the CCS design differently. Furthermore, the actual programming technique is different for every system. Based on these discussions, the detailed functional description of the system has been developed (Section 9.2.7). This would enable a system supplier to design, build and program his system. However, an intimate knowledge of the process will be required for a successful start-up.

The interfacing of the mechanical equipment to the CCS is through the various sensors, control valves and interlocks in the drive starters as described in Sections 9.2.2 to 9.2.6 and 8.2.3.

As a reference, the undermentioned list of suppliers were consulted who expressed interest in the DSS Mobile Plant CCS:

..../3-

Bailey Controls
Honeywell Canada
Fisher and Porter Canada
Texas Instrument Canada
Action Instruments (rep. MacDonald Process Equipment).

Copies of these two letters will be included in the front of the final report.

On issuance of these final reports, Fenco's contractual requirements are fulfilled.

We wish you every success in the implementation of the mobile plant and are confident it will be a valuable tool in helping resolve the problems encountered in fine coal cleaning.

Yours truly,
FENCO ENGINEERS INC.

David S Webster

David S. Webster
Project Manager

DSW/jg

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Research and Technology
Recherche et Technologie

Canada Centre for Mineral and Energy Technology,
Centre canadien de la technologie des minéraux et de l'énergie,

Coal Research Laboratories
Laboratoires de Recherches sur le Charbon

P.O. Bag 1280
Devon, Alberta
T0C 1E0

Your file Votre référence

Our file Notre référence

February 18, 1985

David S. Webster
Senior Process Designer
Coal Department
Fenco Engineers INC.
33 Yonge Street
Toronto, Ontario
Canada M5E 1E7

Dear David,

Re: Phase III Report - Detail Design
Design and Development of a Fine Coal Cleaning Mobile Plant

We studied the above report with great interest. The report is acceptable. It contains all the details, necessary to construct and operate the fine coal cleaning mobile plant with froth flotation and spiral concentrator process options. The following are our comments on the report:

1. A section on what is required of Operating preparation plant would be beneficial:
   - Power supply (as stated on page 8-1)
   - Water (m3/h) and pressure
   - Fines slurry from what section of the plant
   - Recirculated water or slurry to the plant
   - Space required for the Mobile plant
   - Handling of products from the mobile plant
   - Required piping from preparation plant to mobile plant and vise-a-versa

2. Please place the necessary tolerances on the dimensions of the designed objects (frames and subframes) to permit assembly with the connecting parts and equipment.

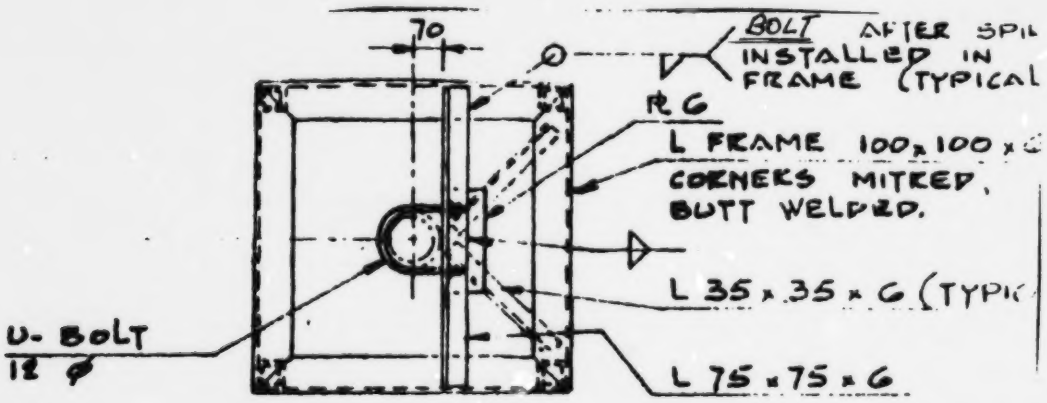
.../2

Canada

3. The title of the drawing No. 42022-P-07 should be: "Process option 7 spiral concentrator 0.5-0.15mm. Material 0.15mm X 0 wasted."

4. Drawing No. 42022-J-03-sub section plan 12.

Please assemble the marked steel member using bolts instead of welds:



5. Please incorporate into the phase III report the determined displacements and member forces in designed sections of supporting structure (structural design) for the condition of operating loads in the state of forced vibration.

6. Please use in all cases the International System of Units (SI).

7. Please check if Sala's vertical pump for frothy suspensions can operate with electric motor 3PH/60HZ/480V. The electric motor recommended by SALA is.3PH/60Hz/575V (see section4).

8. Please consider all piping as a Schedule 80 PVC.

9. There is a need for more precise explanation of a logic sequence diagram (drawings 42022-J-11 to 42022-I-17), especially at a node points (dotted lines), do they mean AND or OR operations?

10. The logic sequence for emergency shut down of an intermediate unit needs clarification.

.../3

11. Central system 8.1.2, 9.1.5
    No specific information and recommendation given concerning what type of equipment (control', micro processor, capabilities, prices, interfacing such as in the case of mechanical side of the plant. Please give specifics rather than the general infromation given in the report.

Yours very truly,

Dr. Eng. Jozef Szymanski
Coal Research Laboratory
Devon, Alberta

JS/vlm

c.c. Dr. H.A. Hamza
M. Mikhail
Z. Potoczny
E. Fresque
W. Irwin
Dr. A. Salama

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SECTION 1

SUMMARY

1.0 SUMMARY

Phase III - Detail Design, the third and final phase, of this project has been duly completed and all engineering and design information is contained herein.

Each engineering discipline, process, electrical, instrumentation and structural has been fully integrated to ensure a practical and competent mobile plant design. All relevent and pertinent details are provided to permit construction quotations to be obtained.

The design of the plant has been complicated and made more arduous than originally contemplated by the fact that the designer (Fenco) has not been contracted to build it. This situation has been further compounded by not having certified construction drawings for equipment.

To avoid confusion and costly errors during the actual construction of the mobile plant there are many facets of the design which must be fully appreciated.

All process equipment has been preselected by Fenco and these items included in our design.

The proprietary items are as listed in Sections 4.0 of this report and Phase II - Process Options Selection report. It will be the responsibility of the construction contractor to confirm all mounting details of the preselected equipment and also undertake any engineering as may be necessary to accommodate changes in equipment selection.

Certain items of equipment will require modification from standard construction to suit plant design and these are detailed in this report.

Considerable effort and thought has been given to the design of the structural framing of the trailer and equipment supports to ensure integrity in both mobile and operational modes. With this objective we have, as mentioned in previous documentation, enjoyed a dialogue with a particular trailer manufacturer and the design established is a result of this joint effort.

Sufficient information regarding the structural design is included herein for any competent trailer manufacturer to undertake the trailer production. We stress, however that the trailer manufacturer must be made responsible for final design.

For both electrical and instrumentation, our design has again been based on preselected items of equipment. Should equipment be used different to that specified herein then all installation and engineering details must be checked prior to construction to prove compatability with our design.

In regard to the need to accurately measure the solids tonnage loading at major points in the process, this apparently has not been done before, and involves new technology. Some of the components employed need to be proven for this particular application. The Micro Motion mass flow meter incorporates a thin wall 'U' tube with a wear life that cannot at this moment be determined. We understand that CRL has a Micro Motion device at the Devon facilities and recommend that this be placed on a test bed for wear life determination. The percentage volume of water in the pulp will be measured by an Auburn conductivity device which is presently under development. These two instruments, the Micro Motion and Auburn, will need to be further studied by C.R.L. prior to construction.

The completion of this phase of the project fulfills the scope of work which Fenco was contracted to undertake. We have designed a single mobile plant featuring those processes determined from a state-of-the-art study and agreed between Fenco and the Scientific Authority. All phases of the work

and the contractual requirements have been diligently followed. The process design and all engineering aspects of this work have only been undertaken after discussion, agreement and authorization to proceed has been provided by the Scientific Authority.

Fenco cannot assume any responsibility for the mobile plant design upon submittal of the final copies of this report and unless additionally contracted, Fenco will have no further involvement with this project.

We consider the mobile plant to fully meet the design objectives outlined in the scope of work and trust that it will greatly assist in solving the processing problems experienced with Canadian fine coals.

SECTION 2

INTRODUCTION

2.0 INTRODUCTION

Phase III - Detail Design has been completed following approval of the Phase II - Process Options Selection report and authorization given by the Scientific Authority to proceed with the engineering.

Although the basic design was fixed upon completion of Phase II it has been necessary to make minor changes to improve the plant operation, accommodate equipment presently available from C.R.L. and different instrumentation.

Two froth pumps have been included to provide better and separate collection of the froth from each bank of froth cells.

Sumps 3 and 4 and Pumps 3 and 4 will be permanently mounted on the trailer.

The Sizing Screen will be the Derrick unit that C.R.L. has already purchased.

Screw Conveyor No. 2 will be permanently mounted on the trailer and collect the discharge from the Dewatering Screen. Process Option No. 6 circuitry has been modified so that the Sizing Screen overflow will be pumped, via Conditioner No. 2, to the Dewatering Screen.

The nuclear density devices have been replaced with Micro Motion mass flow meters and Auburn conductivity devices included to measure the percentage volume of water in the slurry.

A froth reagent addition system has been included, comprising three chemical storage tanks and thirteen metering pumps.

SECTION 3

PROCESS

3.0 PROCESS

3.1 General

This section contains specific instructions and guidelines for the safe and proper operation of the mobile plant with regard to processing.

3.2 Process Options

The mobile plant has been designed to make the assembly of the process options as simple as possible.

Mounted on the trailer at all times will be the permanent process equipment and a bank of large froth flotation cells, Bank No. 1.

A decision which will need to be made, and put into effect, is which process equipment shall be mounted on the trailer at Devon to supplement the large cells. The alternatives, are the banks of small froth flotation cells, the second bank of large cells or the spiral concentrator.

With froth cells Bank No. 2 installed it will be possible to achieve process options 1, 2 and 3 by simply changing pipe discharge connections.

With the spiral concentrator installed it will be possible to achieve process options 3, 4, 5, 6 and 7 also by changing pipe discharge connections.

These piping changes can be easily made in the field.

The choice of which type of froth flotation cell to mount on the trailer will also need to be made at Devon, the alternatives being open trough or cell to cell.

The froth flotation cell options are listed below:

Froth Cell Bank No.	Equipment	Removable Module No.
1a	5 x 10 cu.ft. Wemco open trough	1
1b	5 x 12 cu. ft. Denver Sub A cell to cell	2
2a	2 (5 x 3 cu. ft.) Denver DR open trough	3
2b	2 (5 x 3 cu. ft.) Denver Sub A cell to cell	4

Table 3-1 shows the process circuit options together with the equipment utilization.

Table 3-2 lists the various process options. These tables may suggest the process option assembly to be more complicated than it actually is. Study of the flowsheets and layout drawing will clearly show the simplicity of the plant and how the process options can be easily achieved.

TABLE 3-1

PROCESS CIRCUIT OPTIONS EQUIPMENT UTILIZATION

Equipment Item	Module	Process Circuit Option							
		1	2	3	4	5	6	7	8
Sump No. 1	Permanent	✓	✓	✓	✓	-	✓	✓	✓
Pump No. 1	Permanent	✓	✓	✓	✓	-	✓	✓	✓
Desliming Screen	Permanent	✓	✓	✓	✓	✓	✓	✓	✓
Screw Conveyor No. 1	Permanent	✓	✓	✓	✓	✓	✓	✓	✓
Sump No. 2	Permanent	✓	✓	-	✓	✓	✓	✓	-
Pump No. 2	Permanent	✓	✓	-	✓	✓	✓	✓	-
Sizing Screen	Permanent	✓	✓	-	✓	✓	✓	✓	-
Conditioner No. 1	Permanent	✓	✓	✓	✓	✓	✓	-	✓
Pump No. 6	Permanent	✓	✓	✓	✓	✓	✓	-	✓
Conditioner No. 2	Permanent	✓	✓	-	✓	✓	✓	✓	-
Pump No. 7	Permanent	✓	✓	-	✓	✓	✓	✓	-
Flotation Cells Bank No.1	Removable 1 or 2	✓	✓	✓	✓	✓	✓	-	✓ ✓ 1&2
Flotation Cells Bank No.2	Removable 3 or 4	✓	✓	-	-	-	-	-	-
Spiral Concentrator	Removable 5	-	-	-	✓	✓	✓	✓	-
Sump No. 3	Permanent	-	-	-	✓	✓	✓	✓	-
Pump No. 3	Permanent	-	-	-	✓	✓	✓	✓	-
Sump No. 4	Permanent	-	-	-	✓	✓	✓	✓	-
Pump No. 4	Permanent	-	-	-	✓	✓	✓	✓	-
Dewatering Screen	Removable 5	-	-	-	✓	✓	✓	✓	-
Screw Conveyor No. 2	Permanent	-	-	-	✓	✓	✓	✓	-
Froth Pump 1	Permanent	✓	✓	✓	✓	✓	✓	-	✓
Froth Pump 2	Permanent	✓	✓	-	-	-	-	-	✓
Dewatering Unit	Separate Trailer	✓	✓	✓	✓	✓	✓	-	✓
Sump No. 5	Permanent	✓	✓	✓	✓	✓	✓	✓	✓
Pump No. 5	Permanent	✓	✓	✓	✓	✓	✓	✓	✓
Water Tank	Permanent	✓	✓	✓	✓	✓	✓	✓	✓

TABLE 3-2

PROCESS EQUIPMENT OPTIONS

Process Options	Process Circuits	Equipment Options
1, 2 & 3	Achieved by pipe changes	Froth Cell Banks 1a or 1b 2a or 2b
3, 4, 5, 6 & 7	Achieved by pipe changes	Froth Cell Banks 1a or 1b
8	Achieved by pipe changes	Both Froth Cell Banks 1a and 1b installed

Process Option	Equipment Option	Froth Cells Installed	Removable Modules Installed
1	1 . 2 1 . 2 1 . 3 1 . 4	1a + 2a 1b + 2b 1a & 2b 1b + 2a	1 & 3 2 & 4 1 & 4 2 & 3
2	2 . 1 2 . 2 2 . 3 2 . 4	1a + 2a 1b + 2b 1a + 2b 1b + 2a	1 & 3 2 & 4 1 & 4 2 & 3
3	3 . 1 3 . 2	1a 1b	1 + (2,3,4 or 5) 2 + (1,3,4 or 5)
4	4 . 1 4 . 2	1a 1b	1 & 5 2 & 5
5	5 . 1 5 . 2	1a 1b	1 & 5 2 & 5
6	6 . 1 6 . 2	1a 1b	1 & 5 2 & 5
7	7 . 1 7 . 2	1a 1b	1 & 5 2 & 5
8	-	1a & 1b	1 & 2

3.3 Start-Up Procedures

A complete and thorough check of the plant must be made, upon arrival at a test plant site, to ensure structural integrity and operational worthiness of the equipment.

Electric power, make-up water tailings pump discharge, raw slurry feed, drains and air (as necessary) connections should then be made.

The selected process option should be proven by checking all pipe routings and power cable connections.

The two screw conveyors will need to be pulled out into their operating position.

The mobile rig carrying the disc filter for dewatering the froth will need to be sited adjacent to the fine coal cleaning mobile plant. All interconnecting process pipework between the two rigs will need to be installed and checked prior to startup.

Each process option will be started up in a specific sequence programmed into the microprocessor.

Likewise, a set procedure will apply when shutting the plant down.

A fail-safe sequence interlock logic will be initiated in an emergency.

3.4 Typical Start-Up

The operator will start the equipment from within Control and Instrumentation Module.

He will initially power up microprocessor and insert floppy disk program. This program will be written by the engineering company undertaking the construction. It will include a check list to prove the process option is completely and correctly assembled.

The check list for each process option is contained in Section 9.

Next step will be to fill all sumps and froth cells with water.

The operator will enter "Fill with Water" command into computer.

Level controllers will be actuated and auto valves open to fill water tank sumps and conditioners.

Sump 5 and froth cells will be filled with water through manual valves and hose pipe.

Full level status of sumps and conditioners will be indicated on screen.

Computer will ask if froth cells charged Y/N.

When system charged with water, permission will be given to start equipment.

Operator will type in a code word to initiate equipment start-up, i.e. "Plant Start" and push command button.

Equipment will start-up in automatic timed sequence.

The graphic flowsheet will show status of each drive. The plant will achieve a closed balance circuit with water only.

At specified points on the circuit the graphic will display volumetric flow rate; TPH solids; % solids by weight and pulp Sg.

Upon achieving steady state balanced water condition the graphic will display status of being ready to process coal.

Operator will open valve on raw slurry feed line sufficient to stop level make-up with water and without overflowing sump.

Operator will open and close respective valves on Pump 5 discharge to divert flow off the trailer.

Operator will initiate starting of froth reagent pumps and set desired dosage rates.

Typical start-up sequence is shown below, the example being for Process Option 1.

TYPICAL START-UP (PROCESS OPTION 1)

Start Sequence	Item Started	Status
1	Screw Conveyor No. 1	Operational
2	Desliming Screen	Operational
3	Flotation Cells Bank 1 Mechanisms and Paddles and Paddles	Operational
4	Flotation Cells Bank 2 Mechanisms and Paddles	Operational
5	Conditioner No. 1 Mechanism	If required
6	Conditioner No. 2 Mechanism	If required
7	Froth Pump No. 1	Sump empty - pump run dry
8	Froth Pump No. 2	Sump empty - pump run dry
9	Pump No. 5	Pump will recirculate on itself via water tank overflow
10	Pump No. 7	Level in Conditioner 2 will be maintained automatically. Cells will discharge to Tailings Sump No. 5
11	Pump No. 6	Level in Conditioner 2 will be maintained automatically. Cells will discharge to Tailings Sump No. 5
12	Sizing Screen	-
13	Pump 2	Level in Sump 2 maintained automatically
14	Pump 1	Level in Sump 2 maintained automatically
15	Blower	Required only if using Denver cells for Bank No. 1

At this point the plant will be operating as a closed circuit with no feed or discharge. Raw slurry can be fed to plant when desired. After short time, valves on Tailings Pump 5 discharge need to be set to deliver to thickener.		
16	Reagent Pumps	Reagent need be added only when coal being fed to plant

Table 3-3 shows a suggested starting sequence for each process option. The operator may vary this sequence, as he desires, for those items at the beginning of a logic loop.

Logic diagrams of the sequence interlocks are included herein and these should be studied by the operator to familiarize himself with this aspect of plant operation.

The plant will be started up such that a closed water balance is maintained as each pump comes on line, until all items are running and the whole plant is operating as a single entity.

On shutdown, upon completion of a test, the systems should be purged with clean water.

3.4.1 Conditioners 1 and 2

It will be required to change from using these as sump/conditioners while the plant is operating. For these particular items of equipment and others the computer programming will allow operator access (by means of special input code) to change the operating parameters.

When changing from sump to conditioner mode, the following operation must be effected:

- Tell computer intention of changing.

- Computer will start stirrer mechanism.

- Also change liquid working to overflow point and start to fill tank with water.

- Operator will go to conditioner tank and when liquid level at overflow and conditioner pipe full, openand close suction valves.
  Conditioner 1: - open Valve 09, close Valve 08
  Conditioner 2: - open Valve 11, close Valve 10

- Operator can command computer to start respective froth reagent pump to feed conditioner.

When changing from conditioner to a sump, the following must be done:

- Operator will need to open Valve 08 (Conditioner 1) open Valve 10 (Conditioner 2).

- Operator will input on computer change in function.

- Computer will stop respective froth reagent pump, stop the stirrer and set level control to sump position.

- Operator will then need to close Valve 09 (Conditioner 1) close Valve 11 (Conditioner 2).

TABLE 3-3

PROCESS EQUIPMENT

SUGGESTED STARTING SEQUENCE

Equipment Item	Process Circuit Option						
	1	2	3	4	5	6	7
Pump No. 1	14	14	8	15	-	15	12
Desliming Screen	2	2	2	2	2	2	2
Screw Conveyor No. 1	1	1	1	1	1	1	1
Pump No. 2	13	12	-	14	15	14	11
Sizing Screen	12	11	-	13	13	10	10
Conditioner No. 1 Mechanism	5	5	4	6	6	6	-
Pump No. 3	-	-	-	11	11	13	8
Pump No. 4	-	-	-	10	10	12	7
Pump No. 5	9	9	6	9	9	11	6
Pump No. 6	11	13	7	-	14	8	-
Pump No. 7	10	10	-	12	12	9	9
Conditioner No. 2 Mechanism	6	6	-	7	7	-	5
Flotation Cells Bank 1	3	3	3	3	5	5	-
Flotation Cells Bank 2	4	4	-	-	-	-	-
Dewatering Screen	-	-	-	5	4	4	4
Froth Pump No. 1	7	7	5	8	8	7	-
Froth Pump No. 2	8	8	-	-	-	-	-
Blower	15	15	-	-	-	-	-
Reagent Pumps	16	16	9	16	16	16	13
Screw Conveyor No. 2	-	-	-	4	3	3	3

3.5 Processing

The processing parameters and loadings of the mobile plant will be site specific and therefore only operational guidelines can be provided herein.

It must be realized that the data base on which the plant has been designed was based on typical and representative conditions existing on present producing plants, but will in practise, vary plant to plant and hour to hour.

However, the process design incorporatesthe felexibility to accept wide shifts in tonnage loadings without detriment to performance.

The flow rate of 50 I gpm (13.64 m^3/h) should be maintained as the normal operating level and adjusted only for extenuating circumstances identified during actual plant operation.

The froth flotation cells nave been sized to provide a 6 minute residence period at a feed rate of 50 I gpm (13.64 m^3/h) for the large cells and 25 I gpm (6.82 m^3/h) for the small cells.

Additionally the conditioning tanks will provide a minimum of 2 minutes residence time at the above flow rates.

The spiral concentrator requires a feed rate of 18 I gpm (5.0 m^3/h) for each of its two starts. Under most process options only one start will be used.

Each pump will be fitted with a variable speed drive permitting the discharge rate to be adjusted as required to suit operating conditions.

3.6 Monitoring and Control

Instrumentation has been provided to measure and control the various loadings throughout the mobile plant and provide the data for determining the performance throughout each processs stage.

All sumps will be fitted with sonic level controls. On Sumps 1, 2, 3, 4 and Conditioners 1 and 2 these controls will actuate valves for the addition of water to maintain desired operating levels. The level control on Sump 5 will control the speed of its respective pump to maintain a desired operating level.

The discharge line of each of the seven pumps, 1, 2, 3, 4, 5, 6 and 7 will be fitted with solids concentration, volumetric flow and mass flow measurement devices.

The volumetric flow meters will be tied into their respective pump variable speed drive so as to maintain the desired flow rate.

These instruments will provide the following data at seven critical points in the circuitry:

i) Flow rate (m^3/h)
ii) Solids concentration (% by volume)
iii) Specific gravity of the pulp
iv) Tonnes per hour of solids
v) Specific gravity of the solids.

From this data a mass balance of the entire plant will be calculated.

The printer will provide a hard copy of the operating conditions repeatedly at timed intervals at the operators requirement but basically every 15 minutes.

A printout will be provided of the mass balance for each of the seven pump discharges in terms of table below:

	m^3/h	TPH	% Vol.	Sg
Solids Water				
Slurry				

Also a printout of the solids tonnages of the 12 load points within the circuitry will be given together with mass balance figures.

Whenever a process parametear change is initiated via the computer this change will be recorded, i.e. conditioner status change, flow rate, etc.

Table 3-4 shows the plant tonnage loadings measurement which will provide the necessary data to monitor and compare the operation of each process option tested.

TABLE 3-4

PLANT TONNAGE LOADING MEASUREMENT

Instrument Location	Data Measured	Process Option 1	2	3	4	5	6	7
Pump No. 1 Discharge	i) Tonnage of Raw Coal being processed	✓	✓	✓	✓	NO	✓	✓
Pump No. 2 Discharge	i) Tonnage of Raw Coal 0.5 mm x 0	✓	x	NO	✓	x	✓	✓
	ii) Tonnage of Raw Coal being processed	x	x	NO	x	✓	x	x
	iii) Tonnage of 0.5 x 0 tailings from primary froth flotation	x	✓	NO	x	x	x	x
Pump No. 3 Discharge	i) Tonnage of Spiral cleaned coal	NO	NO	NO	✓	✓	x	✓
	ii) Tonnage of Spiral cleaned coal plus Raw Coal minus 0.15 mm	NO	NO	NO	x	x	✓	x
Pump No. 4 Discharge	i) Tonnage of Spiral reject	NO	NO	NO	✓	✓	✓	✓
Pump No. 5 Discharge	i) Total tonnage of plant reject	✓	✓	✓	✓	✓	✓	✓
Pump No. 6 Discharge	i) Tonnage of Raw Coal minus 0.15 mm	✓	x	x	✓	✓	✓	NO
	ii) Tonnage of Raw Coal 0.5 mm x 0	x	✓	✓	x	x	x	x
Pump No. 7 Discharge	i) Tonnage of Raw Coal 0.5 x 0.15 mm	✓	✓	NO	✓	✓	x	✓
	ii) Tonnage of Spiral cleaned coal	x	x	NO	x	x	✓	x
	Tonnage of plus 0.5 mm oversize measured as follows: -							
	a) Difference between Pump 1 tonnage and Pump 2 tonnage	✓	x	x	✓	NM	✓	✓
	b) Difference between Pump 1 tonnage and Pump 6 tonnage	x	✓	✓	x	x	x	x
Note: tonnages of frothed cleaned coal not measured								

Key:

✓ - applies to that process option
x - does not apply to that process option
NO - Pump and instrument "not operated" in that process option
NM - "Not Measured" in that process option.

3.7 Flowsheets

Flowsheets drawing number 42022-P-01 through 07 inclusive have been revised to reflect the final process design and copies are included herein.

42022-P-01	Rev.	0	Flowsheeet	-	Process Option	1
-P-02	"	0	"	-	" "	2
-P-03	"	0	"	-	" "	3
-P-04	"	0	"	-	" "	4
-P-05	"	0	"	-	" "	5
-P-06	"	0	"	-	" "	6
-P-07	"	0	"	-	" "	7
42022-P-37	Rev.	0	Froth Reagent Addition System			

WATER
FT
T. P.
LT
WATER TANK
BANK 1 FLOTATION CELLS
0.15 X 0.0
FROTHER
TO THICKENER
T. P.
MT
AT
FT
0.5 X 0.0
SIZING SCREEN
0.15mm
0.5 X 0.15
BANK 2 FLOTATION CELLS
FROTHER
FROTH PUMP No. 2
FROTH PUMP No. 1
T. P.
T. P.
SUBJECT TO APPROVAL BEFORE CONSTRUCTION
T. P.
FT
LT
CONDITIONER 1
CONDITIONER 2
COLLECTOR
FROTHER
DEWATERING UNIT
CLEAN COAL
SUMP 1
PUMP 1
SUMP 2
PUMP 2
PUMP 6
PUMP 7
SUMP 5
PUMP 5
T. P.
TO FLOAT FLOTATION

NOTES AND REFERENCES

DESIGN DETAILS
FROTH FLOTATION OF THE SIZE FRACTIONS :
0.15mm NOMINAL SIZE.
ACTUAL SIZE SITE SPECIFIC.

LEGEND :

- LT — LEVEL TRANSMITTER
- FT — VOLUMETRIC FLOW TRANSMITTER
- MT — SOLIDS FLOW TRANSMITTER
- AT — CONDUCTIVITY TRANSMITTER
- T. P. — TERMINATION POINT

NO.	REVISION	DATE	BY
DES.	11 JAN. 1988		
DRAWN	MARC ROSS		
CHECKED	D. S.		
APPR.			
ISSUE DATE			
ISSUED FOR			

PROJECT TITLE
CANMET : COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

DRAWING TITLE
FLOWSHEET
PROCESS OPTION 1

Fenco
FENCO ENGINEERING INC

SCALE NONE

DRAWING NUMBER 42002-F-01

REV. 0

PROCESS DETAILS
TWO STAGE FROTH FLOTATION
RE-CLEANING OF SPIRAL
PRIMARY TAILINGS
0.15mm NOMINAL SIZE.
ACTUAL SIZE SITE SPECIFIC.

LEGEND :

- LT — LEVEL TRANSMITTER
- FT — VOLUMETRIC FLOW TRANSMITTER
- MT — MASS FLOW TRANSMITTER
- AT — CONDUCTIVITY TRANSMITTER
- T.P. — TERMINATION POINT

WATER
WATER TANK
BANK 1 FLOTATION CELLS
FROTHER
0.5 X 0.0
SCREENING SCREEN
0.5mm
FINE 0.5mm OVERSIZE
SCREEN CONVEYOR No. 1
SIZING SCREEN
0.15mm
BANK 2 FLOTATION CELLS
FROTH PUMP No. 2
FROTH PUMP No. 1
0.5 X 0.15
TO THICKENER
SUBJECT TO APPROVAL BEFORE CONSTRUCTION
SUPERSONITIVE SAMPLE
SUMP 1
PUMP 1
SUMP 2
PUMP 2
CONDITIONER 1
PUMP 6
CONDITIONER 2
PUMP 7
COLLECTOR
PROMOTER
DEWATERING UNIT
CLEAN COAL
SUMP 3
PUMP 5
OVERFLOW
TO PLANT FLUSH SUMP

NO.	REVISION	DATE	BY
DES. DATE	11 JAN. 1985		
DRAWN BY	MARC ROSS		
CHECKED BY	D.S.		
DEPT. HEAD		FINAL APPR.	D. WEBSTER

ISSUED DATE

ISSUED FOR

PROJECT TITLE
CANMET - COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

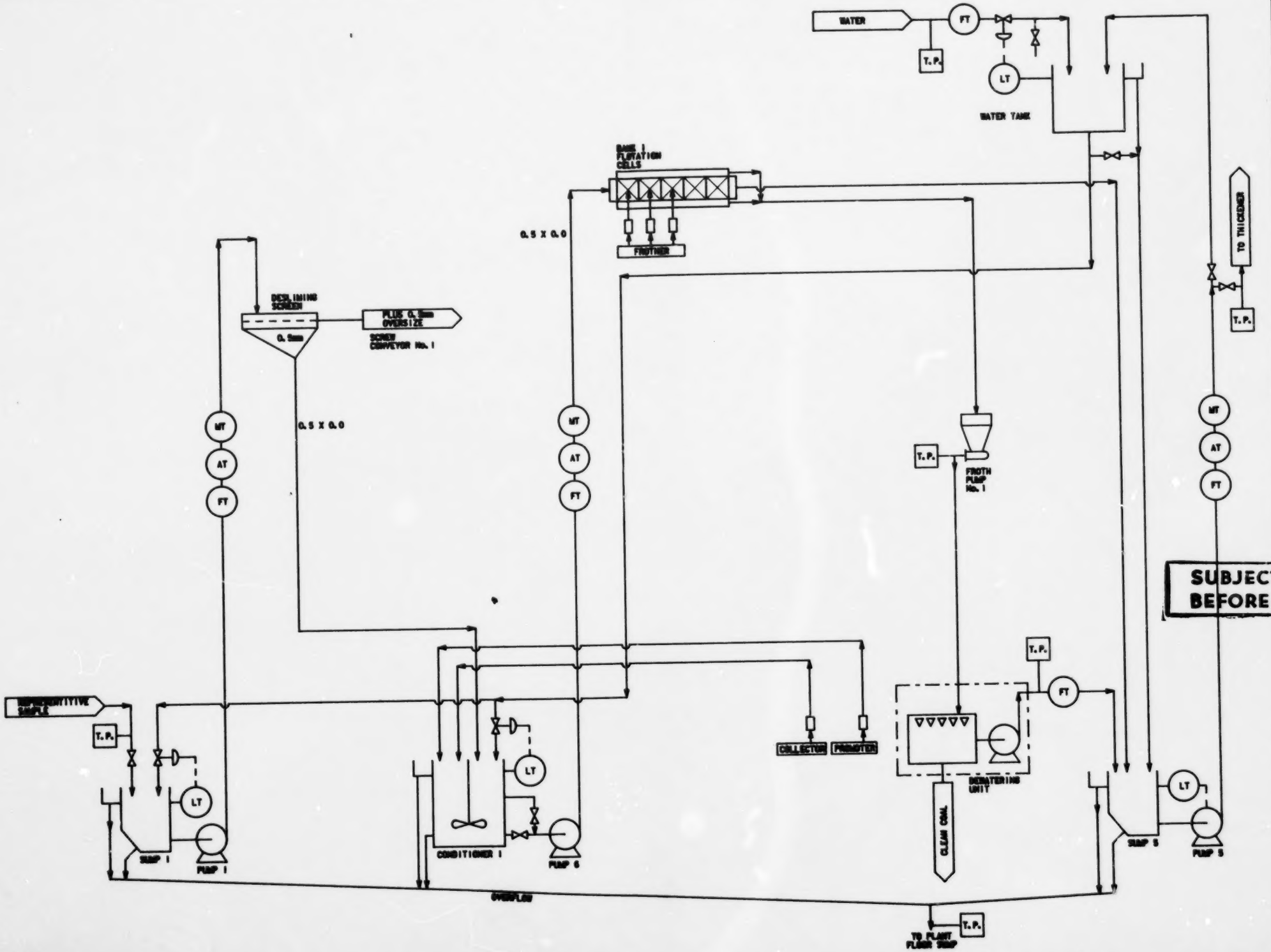
DRAWING TITLE
FLOWSHEET
PROCESS OPTION 2

Fenco
FENCO ENGINEERS LTD

SEALS NONE

DRAWING NUMBER 42022-P-02

REV. 0



PROCESS OPTION 3
FROTH FLOTATION SINGLE STAGE
0.5 X 0.0

LEGEND :

- LT — LEVEL TRANSMITTER
- FT — VOLUMETRIC FLOW TRANSMITTER
- MT — MASS FLOW TRANSMITTER
- AT — CONDUCTIVITY TRANSMITTER
- T.P. — TERMINATION POINT

NO.	REVISION	DATE	BY
DRWG. DATE	11 JAN. 1988	ORIENTATION	SHEET
DRAWN BY	MARC ROSS		
CHECKED BY	D.S.		
DEPT. HEAD		APPR. MGR.	D. WEBSTER
ISSUE DATE			
ISSUED FOR			

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

PROJECT TITLE
CANMET : COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

DRAWING TITLE
FLOWSHEET
PROCESS OPTION 3

Fenco
FENCO ENGINEERS INC

HOLD: NONE

DRAWING NUMBER: 42022-P-03

REV. 0

WATER

FT

T.P.

LT

WATER TANK

0.15 X 0.0

PRIMARY FLOTATION CELLS

TO THICKENER

T.P.

0.5 X 0.0

SIZING SCREEN

0.15mm

SECONDARY SPIRAL

0.5 X 0.15

DEWATERING SCREEN

CLEAN COAL

SCREEN CONVEYOR No. 2

T.P.

FROTH PUMP No. 1

T.P.

FROTH FLOTATION

COLLECTOR

CONDITIONER

SUMP 1

PUMP 1

SUMP 2

PUMP 2

CONDITIONER 1

PUMP 6

CONDITIONER 2

PUMP 7

SUMP 3

PUMP 5

SUMP 4

PUMP 4

DEWATERING UNIT

CLEAN COAL

T.P.

FT

SUMP 5

PUMP 8

T.P.

TO SPOIL

MT — MASS FLOW TRANSMITTER

AT — CONDUCTIVITY TRANSMITTER

FT — VOLUMETRIC FLOW TRANSMITTER

LT — LEVEL TRANSMITTER

T.P. — TERMINATION POINT

PROCESS OPTION 4

SPIRAL CONCENTRATOR 0.5 X 0.15

FROTH FLOTATION 0.15 X 0.0

0.15mm NOMINAL SIZE.

ACTUAL SIZE SITE SPECIFIC.

NO.	REVISION	DATE	BY

DRAWN 11 JAN. 1988

DRAWN BY MARC BROS

ENGINEER B.S.

DEPT. HEAD

FINAL APPR. B. WEBSTER

ISSUE DATE

ISSUED FOR

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

PROJECT TITLE

CANMET - COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

DRAWING TITLE

FLOWSHEET
PROCESS OPTION 4

Fenco

FENCO ENGINEERING ZUG

SCALE NONE

DRAWING NUMBER 42002-P-04

REV. 0

WATER

FT

T. P.

LT

WATER TANK

TO THICKENER

T. P.

0.15 X 0.0

FROTHER

MT

AT

FT

0.5 X 0.0

SIZING SCREEN

0.15 X 0.15

CLEAN COAL

T. P.

FROTH PUMP NO. 1

T. P.

FT

T. P.

TO DRAIN

SUMP 2

PUMP 2

CONDITIONER 1

PUMP 6

CONDITIONER 2

PUMP 7

SUMP 3

PUMP 3

SUMP 4

PUMP 4

SUMP 5

PUMP 5

LT

GENERAL OPTION 5

SPIRAL CONCENTRATOR 0.15 TO 0.0
FROTH FLOTATION 0.15 X 0.0
0.15mm MINERAL SIZE,
ACTUAL SIZE SITE SPECIFIC.

LEGEND :

- LT — LEVEL TRANSMITTER
- FT — VOLUMETRIC FLOW TRANSMITTER
- MT — MASS FLOW TRANSMITTER
- AT — CONDUCTIVITY TRANSMITTER
- T. P. — TERMINATION POINT

NO.	REVISION	DATE	BY
DATE 11 JAN. 1988			
DRAWN BY MARC ROSS			
APPROVED BY B. S.			
DEPT. HEAD		FINAL APPR. B. WEBSTER	
ISSUE DATE			
ISSUED FOR			

PROJECT TITLE
CANMET - COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

DRAWING TITLE
FLOWSHEET
PROCESS OPTION 5

Fenco
FENCO ENGINEERING INC

SCALE NONE

DRAWING NUMBER 43002-P-05

REV. 0

WATER

FT

T. P.

LT

WATER TANK

BANK I FLOTATION CELLS

0.15 X 0.0

FROTHER

TO THICKENER

T. P.

0.5 X 0.0

REICHERT SPIRAL

MT

AT

FT

SIZING SCREEN

0.15mm

DEWATERING SCREEN

SCREEN CONVEYOR No. 2

T. P.

FROTH PUMP NO. 1

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

T. P.

DEWATERING UNIT

CLEAN COAL

T. P.

TO BASIN

SUMP 1

PUMP 1

SUMP 2

PUMP 2

CONDITIONER 1

PUMP 6

CONDITIONER 2

PUMP 7

SUMP 3

PUMP 3

SUMP 4

PUMP 4

SUMP 5

PUMP 5

PROCESS OPTIONS

REICHERT SPIRALS 0.5 X 0.15

FROTH FLOTATION 0.15 X 0.0

0.15mm NOMINAL SIZE.

ACTUAL SIZE SITE SPECIFIC.

LEGEND :

LT — LEVEL TRANSMITTER

FT — VOLUMETRIC FLOW TRANSMITTER

MT — MASS FLOW TRANSMITTER

AT — CONDUCTIVITY TRANSMITTER

T. P. — TERMINATION POINT

NO.	REVISION	DATE	BY
	ISSUED 11 JAN. 1988		

DRAWN BY: MARC ROOS

APPROVED BY: D.S.

DEPT. HEAD: D. WEBSTER

ISSUE DATE

ISSUED FOR

PROJECT TITLE

CANMET - COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

DRAWING TITLE

FLOWSHEET
PROCESS OPTION 6

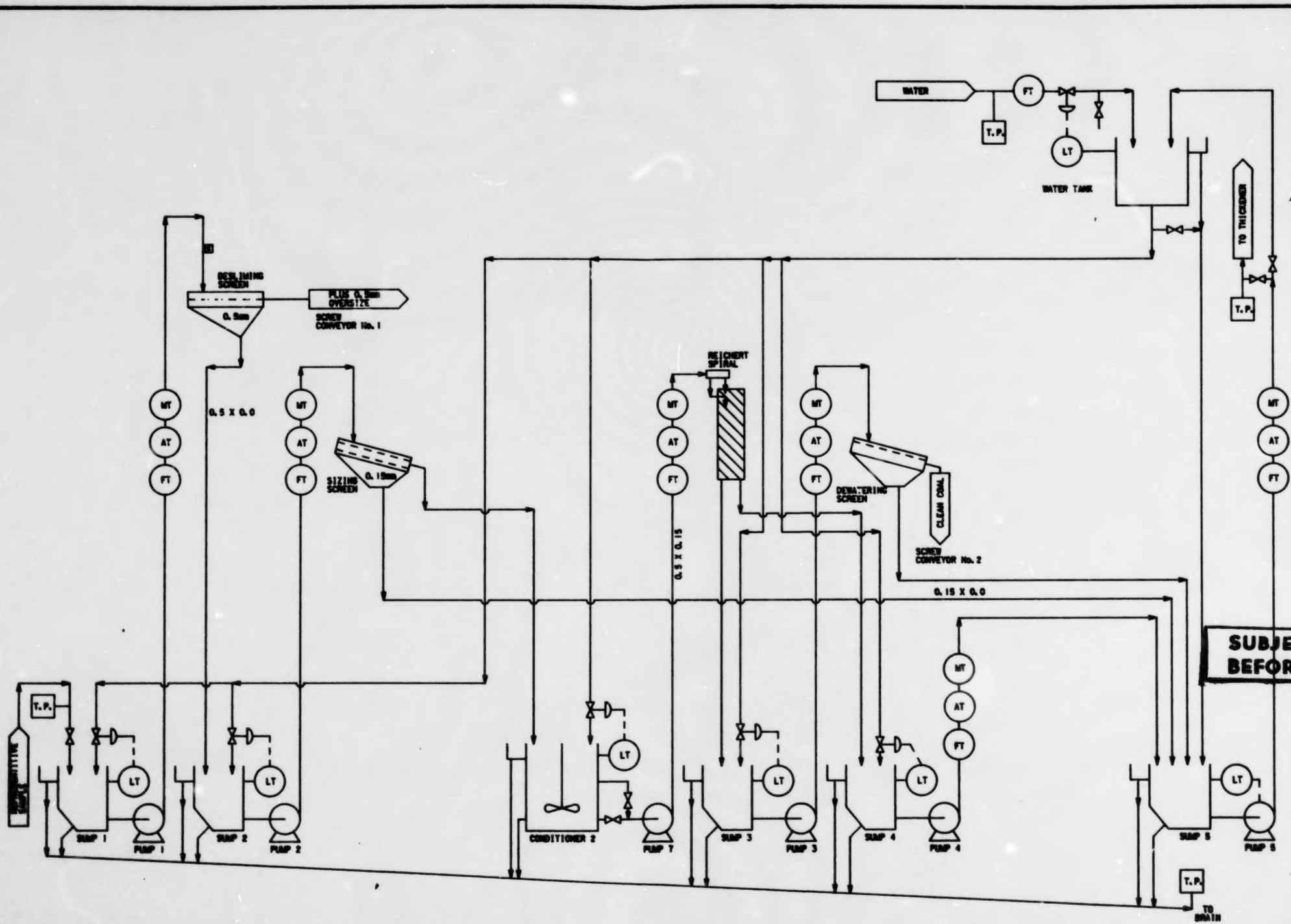
Fenco

FENCO ENGINEERS LTD

WELD: NONE

PROJECT NUMBER: 42002-2-08

DRG. NO.



NOTES AND REFERENCES

PROCESS OPTION 7
REICHERT SPIRALS 0.5 X 0.15
MATERIAL 0.15 X 0 MINTEK.
0.15mm NOMINAL SIZE.
ACTUAL SIZE SITE SPECIFIC.

LEGEND :

- LT — LEVEL TRANSMITTER
- FT — VOLUMETRIC FLOW TRANSMITTER
- MT — MASS FLOW TRANSMITTER
- AT — CONDUCTIVITY TRANSMITTER
- T.P. — TERMINATION POINT

NO.	REVISION	DATE	BY
ORIG. DATE	11 JAN. 1985	ORIENTATION	PROJ.
DRAWN BY	MARC ROOS		
CHECKED BY	D. S.		
DEPT. HEAD		PROJ. ENGR.	D. WEBSTER
ISSUE DATE			
ISSUED FOR			

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

PROJECT TITLE
CANMET : COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

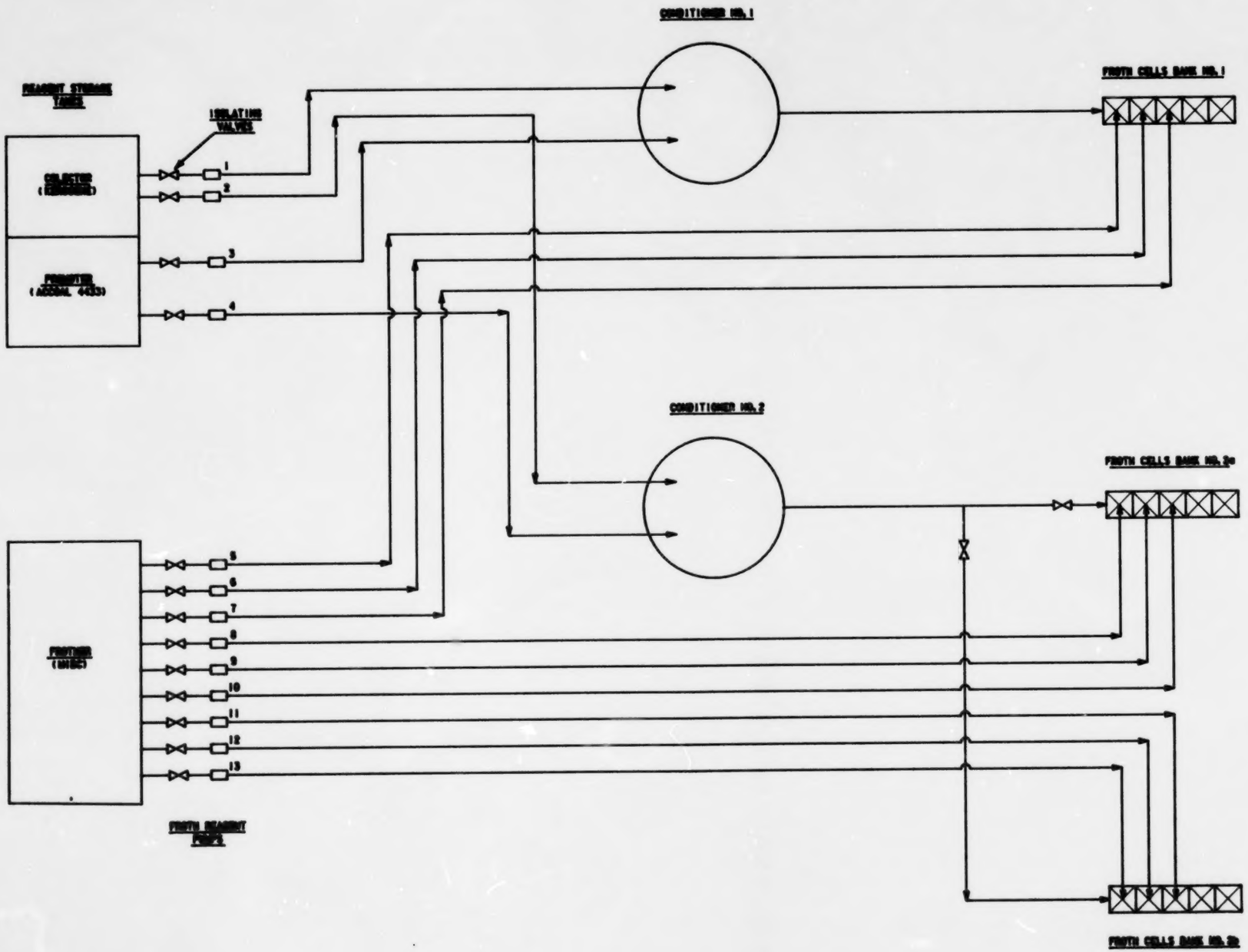
DRAWING TITLE
FLOWSHEET
PROCESS OPTION 7

Fenco
FENCO ENGINEERS INC

SCALE: NONE

DRAWING NUMBER: 42022-P-07

REV. 0



NO.	REVISION	DATE	BY
ORIG. DATE	11 JAN. 1988	ORIENTATION	SIZE
DRAWN BY	MARC ROOS		
CHECKED BY	B.S.		
APPD. BY		FINAL APPD.	B. KEBBITER

ISSUE DATE

ISSUED FOR

PROJECT TITLE
CANMET - COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

DRAWING TITLE
FROTH REAGENT ADDITION SYSTEM

Fenco
FENCO ENGINEERS INC

SCALE NONE

DRAWING NUMBER 42022-P-37

REV. 0

SIEBTECHNIK PRODUCTS

tema inc.

11584 GOLDCOAST DRIVE □ CINCINNATI, OHIO 45242 □ 513 • 489-7811 Telex 21-4630

QUOTATION NO. 645

August 6, 1984

TEMA DEWATERING SCREEN
MODEL WF-50-I

Fenco Engineers, Inc.
33 Young Street
Toronto, Ontario, Canada
M5E 1E7

Attention: Mr. David Webster

Dear Mr. Webster:

We are pleased to quote as follows on our Tema Dewatering Screen in accordance with specifications discussed:

ONE (1) TYPE-WF 50/1 TEMA DEWATERING SCREEN.
Screen Width: 19 3/4"
Screen Length: 68 1/2"
Drive: Two (2) 0.6 kw motors with eccentric drives, 460 volt, 60 cycle, 3 phase. Complete with dual electrical starter control.
Incline Angle: Approximately 5 degrees.

The heavy-duty filter screen consists of strong annealed, mild steel trough, resistant against vibrations with interchangeable screen panels situated in the bottom and backside. The side windows are also interchangeable. The screens are made of wedgewire stainless steel material and include the following per machine:

Four (4) bottom screens, 0.2 mm slot opening.

All vibrations are absorbed by robust rubber isolators.

The drive units are mounted on a heavy-duty support structure above the trough.

The virtually maintenance-free vibration units allow wide oscillation amplitudes of 5 to 9 mm. Motors are dust and water-tight.

PRICE: F.O.B Cincinnati, Ohio.....U.S. $7,985.00

TEMA, INC.
11584 GOLDCOAST DRIVE
CINCINNATI, OHIO 45242

The following terms and conditions of sale, together with the provisions set forth on the face hereof, shall constitute the entire contract between Tema, Inc. (hereinafter referred to as the "Seller") and the purchaser whose name appears on the face hereof (hereinafter referred to as the "Buyer").

PRICES

1. Are F.O.B. manufacturer's plant in Mulheim (Ruhr), West Germany, unless otherwise stated.
2. Are subject to change without notice and may be withdrawn at any time prior to our acceptance of your order by our Home Office. In any event, prices become invalid thirty (30) days after date of quotation.
3. Do not include any excise, sales, use, transportation taxes of any taxing authority and any import duties or license fees. If not included in the invoice for the equipment, such taxes, duties or fees may be invoiced at a later date.

CANCELLATION

1. Buyer may terminate this contract only with the consent of the Seller. This consent can only be given by representatives of the Home Office.
2. The Seller shall promptly notify the Buyer as to the amount of cancellation charges, if any, and failure to pay the same when invoiced will void any prior agreement by Seller to cancel.

DELIVERY

1. As stated in this quotation, is subject to prior sale and to confirmation by the manufacturer's plant in Mulheim (Ruhr), West Germany, at the time of placing the order. Subsequent to delivery. Buyer assumes all risk of loss, or of damages to the equipment. It shall be Buyer's responsibility to obtain insurance on the equipment in transit and extended coverage on the equipment at Buyer's plant, with Seller being named as an additional insurer on such insurance until the price shall be paid in full.
2. Is subject to unavoidable delays and Seller shall be free of any and all liability and penalty for delayed shipment because of strikes, fire, accident, explosion or acts of God and any other causes beyond Seller's control.
3. Is based on the assumption that, if the electrical equipment is not supplied by Seller, the electrical equipment specification sheets with complete information will be in Seller's hands within one (1) week after receipt by Buyer of Seller's electrical equipment recommendations and that complete electrical equipment will be received by Seller at manufacturer's plant in Mulheim (Ruhr), West Germany, at least three (3) weeks prior to the scheduled shipping dates unless Seller specifies an earlier date.

RENEGOTIATION

Seller only agrees to renegotiation if, when, to the extent and in the manner required by Federal law.

TERMS OF PAYMENT

Unless otherwise specified, are net thirty (30) days from date of invoice, subject to approval of Seller's Credit Department at its Home Office. No cash discount allowed.

WARRANTY

Seller warrants to the original Buyer that the equipment will be, at the time of delivery F.O.B. manufacturer's plant Mulheim (Ruhr), West Germany, and for a period of one (1) year from such delivery, free from defects in material and workmanship under normal and proper use and operating conditions. In the event of breach of the foregoing warranty, Seller's obligation, and Buyer's exclusive remedy, shall be limited, at Seller's option and cost, to repair of the defective part or replacement thereof F.O.B. manufacturer's plant Mulheim (Ruhr), West Germany. It is the Buyer's responsibility to install the replacement parts. Buyer shall not return the equipment or parts unless so authorized in writing by Seller.

Buyer's failure to give written notice within thirty (30) days upon discovery of any alleged defect shall constitute a waiver by Buyer of all claims with respect thereof. Notwithstanding the foregoing, Seller shall have no obligation hereunder if the equipment becomes defective in whole or in part as a result of assembly, adjustments, installation, break-in, use, repairs, or maintenance not made in accordance with the operator's manual or as a result of operation on wrong voltages, use in excess of or beyond rated capacities, inadequate, or improperly constructed foundation or structural support.

EXCEPT AS SET FORTH HEREIN, AND EXCEPT AS TO TITLE, IT IS AGREED (a) THAT THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, NOR OTHER WARRANTY, EXPRESS, IMPLIED, OR STATUTORY, NOR ANY AFFIRMATION OF FACT, OR PROMISES, BY SELLER WITH REFERENCE TO THE EQUIPMENT AND (b) THAT BUYER ACKNOWLEDGES THAT IT IS PURCHASING THE EQUIPMENT STRICTLY ON THE BASIS OF THE COMMITMENTS OF SELLER SET FORTH HEREIN.

In no event shall Seller be liable for anticipated profits, or for incidental or consequential damages or for any claims arising out of or resulting from the operation or use of the equipment and Buyer shall indemnify Seller and hold Seller harmless from any claims, awards or judgments with respect to any of the foregoing.

Compliance with OSHA regulations is, by law, a responsibility of the employer/purchaser, rather than the equipment supplier, and is dependent upon proper installation, operation and maintenance at the user site. Therefore, it is inappropriate for Seller to warrant compliance of equipment it supplies.

Seller requests that Buyer inform it of any specific requirements with respect to Seller's equipment that Buyer feels are necessary to assure Buyer's compliance with OSHA regulations.

If these requirements necessitate changes, Seller will advise Buyer of any price and/or delivery adjustments that result.

INDUSTRIAL PROPERTY INDEMNITY

In the event a charge or notice of infringement of a U.S. Patent is directed to Buyer, or a suit instituted against Buyer which charge, notice or suit is based upon any claim that the equipment, or normal use thereof, constitutes an infringement of a U.S. Patent, Buyer and Seller agree that Seller shall, at its cost, dispose of the charge in the manner it deems best, provided Buyer notifies Seller in writing within ten (10) days from receipt by Buyer of the first notice of infringement. Buyer agrees to assist Seller, against reimbursement to Buyer of its reasonable out-of-pocket expenses, in all reasonable manner in the defense or settlement of any charge, or notice of, or suit for infringement. Seller shall have no patent obligation or other liability to Buyer for infringement of patents other than U.S. Patents; or for infringements arising from use of the equipment in processes covered by patents, or in combinations with other equipment; or arising from any alterations made in the equipment by Buyer.

Buyer agrees to indemnify and save harmless Seller in similar fashion where the alleged infringement is the result of the design or other special requirements specified by Buyer or the result of the application or use to which the equipment is put by Buyer, or by others.

The foregoing provisions of this section state the entire liability of Seller in respect of potential industrial property infringement by the equipment and shall be in lieu of all other warranties, express, implied or statutory respecting any potential infringement.

CATALOGS AND MANUALS

Handbooks, catalogs, drawings and operators' manuals supply general information only and Seller makes no representations or warranties thereon. All such materials shall be treated by Buyer as confidential and shall not be transferred, sold or disclosed to any other person or entity.

INSTALLATION AND START-UP

Buyer shall be totally responsible for unloading, assembling, installation, start-up, operation and maintenance of equipment.

TITLE

Until full payment of all obligations of Buyer hereunder, Seller reserves title to the equipment whether or not attached to realty and the same shall be considered as personal property.

In any proceedings or actions relating to default by Buyer, Seller shall be reimbursed for attorney's fees and other costs incurred by Seller in respect thereof. If requested by Seller, Buyer shall execute and deliver to Seller such security agreements, financing statements or other appropriate instruments as Seller may request in order that the equipment shall serve as unencumbered security for the obligations of Buyer hereunder or to enable Seller to comply with all applicable filing or recording laws.

SERVICE

All service work on standard and special machines not covered by Seller's warranty or after the warranty period has expired, will be charged for at the prevailing rate, plus all expenses, transportation, material and parts.

ENGINEERING CHANGES

The specifications contained herein were in effect at the time this quotation and/or catalog were approved for printing. Seller reserves the right to discontinue or to make changes on any model at any time and to change specifications or design without notice and without incurring obligation. All engineering changes from the original specifications requested by Buyer shall be billed separately to Buyer at prevailing Seller engineering rates on actual time expended basis.

GENERAL

Any notice given pursuant to this agreement by either party shall be given in writing to the respective addresses set forth on the reverse side hereof by telex or first class prepaid mail. The construction, performance and validity of this agreement shall be determined in all respects by the laws of the State of Ohio.

In the event of conflict between the foregoing and any other written or oral representations or understandings, the foregoing will control.

Shipment: 14-16 weeks after receipt of order.

Terms: Net 30 days.

Very truly yours,

William P. Bruestle
Sales Engineer
TEMA, INC.

WPB:ed

Enclosure: Dewatering Screen Bulletin

The W. S. Tyler Company of Canada, Limited
A Subsidiary of
Combustion Engineering, Inc.
Post Office Box 3006
St.Catharines, Ontario L2R 7B6

Tel. 416/688-2644
Telex: 061-5124

C-E TYLER

June 29, 1984

Fenco Engineers Inc.,
33 Yonge Street,
Toronto, Ontario. M5E 1E7

Attention: Mr. D. Webster

Subject: Vibrating Screen
Mobile Coal Slurry Plant

Dear Sir:

At the request of our Mr. G. Baker who spoke with you recently, we are pleased to confirm that a 2' x 4' one surface Type 110 Ty-Rocket screen should be more than adequate to handle a revised feed rate of 50 Imperial GPM coal slurry feed containing 12-15% solids analyzing 15-25% plus 1/2mm. Base price for this unit is $6,120.00. All other accessories will be the same as outlined in our June 13, 1984 letter.

We trust our letter contains the information you require at this time. We are enclosing two copies of installation dimension drawing O-4672 illustrating a 2' x 4' one surface below shaft screen for your perusal, and in the event we can be of further assistance please do not hesitate to contact us.

Yours very truly,

C-E TYLER,

J. R. Gilmore/per B.M.

J.R. Gilmore
Machinery Sales Supervisor

JRG/bm

Encls.-(2) Dwg. O-4672

The W. S. Tyler Company of Canada, Limited
A Subsidiary of
Combustion Engineering, Inc.
Post Office Box 3006
St.Catharines, Ontario L2R 7B6

Tel. 416/688-2644
Telex: 061-5124

JUN 15 REC'D

TYLER

June 13, 1984

Fenco Engineers Inc.,
33 Yonge Street,
Toronto, Ontario. M5E 1E7

Attention: Mr. D. Webster

Subject: Vibrating Screen
Mobile Coal Slurry Plant

Dear Sir:

In response to your June 12, 1984 telephone request, we are enclosing herewith one print of installation dimension drawing O-4291 illustrating a 2' x 6' one surface Type 110 Ty-Rocket screen in open body configuration. This unit should be more than adequate to handle a coal slurry feed of 100 Imperial GPM that contains 12-15% solids analyzing 15-25% plus 1/2mm.

For budgetary purposes we offer the following price work-up:

Base Machine	$6,595.00
Feed Box w/o Liner	195.00 ✓
Tube Cover	215.00 ✓
Drive Guard	230.00 ✓
Panel End Wedges	300.00 ✓
2 HP Motor	210.00 ✓
Fines Hopper in Body	1,005.00 ×
Deck Coverings	Extra ✓

We trust our letter and the enclosed drawing contains the information you require at this time. If we can be of further assistance please do not hesitate to contact us.

Yours very truly,

THE W.S. TYLER COMPANY OF CANADA, LTD.,

J. R. Gilmore /pe B.M.

J.R. Gilmore
Machinery Sales Supervisor

JRG/bm

Encl.-(1) Dwg. O-4291

SPECIALIZED INDUSTRIAL EQUIPMENT
• Solenoid Valves & Electronic Controls
• Pressure & Vacuum Process Equipment
• Industrial Chemicals

FINNAN

FINNAN ENGINEERED
PRODUCTS LIMITED

1140 BELLAMY ROAD NORTH, UNIT 22 • SCARBOROUGH, ONTARIO M1H 1H7 • PHONE (416) 438-8070 • TELEX 065-25475

November 7, 1984

Fenco Engineers Inc.
33 Yonge Street
Toronto, Ontario
M5E 1E7

Attention: Mr. David S. Webster
Senior Process Designer

RE: PRECISION METERING PUMPS
CANMET PROJECT

Dear Mr. Webster:

We wish to acknowledge and thank you for your letter of October 25, 1984. The pumps as quoted will all have identical wetted parts materials of construction. Our Model 500-67 Spare Parts Kit is common to any one of the thirteen pumps. The 500-67 is described on Bulletin 4700-67 which is enclosed.

COLLECTOR

2 only — Model 10671-96R Metering Pumps. Pumps are drivers only and are paced by our 5172-03 remote sentrol control. Manual/off/auto.

Price each $1,190.00

PROMOTER

2 only — As per Collector — Price each $1,190.00

FROTHER

9 only — Model 10671-92R Metering Pumps as per item #1 except flow rate .141 to .004 USGPH.

Price each $1,192.00

. . . 2/

Fenco Engineers Inc. November 7, 1984

Wetted Parts Materials of Construction common to all pumps.

Fittings and Head:	PVC
Valve Balls:	Ceramic
"O" Rings:	Teflon
Diaton:	Teflon

Spare Parts Kit (Common to all pumps)

Model 500-67 Spare Parts Kit includes all "O" Rings, Balls and Gaskets necessary to renew liquid handling assembly.

Price each $ 41.75

Model 4959 Diaton common to all pumps

Price each $ 47.35

Prices quoted in Canadian funds, F.O.B. Toronto, taxes are extra and delivery is 3-5 weeks. Prices are firm for a period of thirty days after which they become subject to change without notice.

We trust the foregoing is satisfactory.

Yours very truly

FINNAN ENGINEERED PRODUCTS LIMITED

Don Blair

DDB:bj

Encl. (3) 4700-67

CODE 67
LIQUID HANDLING ASSEMBLY
10000 Series

CAUTION:
When pumping any dangerous chemical make certain that all tubing and/or pipe is securely attached to the fittings, and that no lines are closed or blocked. It is recommended that tubing or pipe lines be shielded to prevent possible injury in case of rupture or accidental damage. Always wear protective clothing when working on or near the pump.

MATERIAL:	
Fittings	PVC
Valve Seat O-Rings	Teflon
Seal Rings	Viton
Balls	Ceramic
Head	PVC
Diaton	Teflon
CONNECTIONS:	
Suction	5/16" OD Tubing
Discharge	5/16" OD Tubing
SPARE PARTS KIT:	
500-67	

A. INJECTION INSTALLATION:

1. Location of the injection point is important.
   (a) If the water line at the injection point has a positive pressure, the injection point may be above or below the solution level in the chemical supply tank.
   (b) If the pressure at the injection point is negative or atmospheric, Part No. 2995-02 anti-syphon valve must be used.
2. If injection check valve is included, install in the line into which chemical is to be injected. This prevents backflow from treated line into the chemical pump. A ½" NPT PVC union should be used between check valve and pipe.
   (a) Install pipe tee which has ¼" outlet. Tee should be schedule 120 PVC material if the chemical solution being pumped is corrosive to metals.
   (b) To insure correct seating of valves, injection check valve should be installed upward in direction of arrows on valve.
   (c) Systems with pipe lines larger than ½" should use the No. 992, ¾" NPT Corporation Stop.

B. ATTACHING THE DISCHARGE TUBING:

(If included)
Note: The discharge tubing is the stiff translucent polyethylene tubing 16 ft. (4.9 meters) long.

1. Cut discharge tubing to required length and route from injection check valve to chemical pump. Do not let tubing touch hot surface or bend sharply. Maximum vertical rise should not exceed 135 ft. (41m). Longer length tubing may be ordered.
2. Slide coupling nut onto tubing.
3. Gently push discharge tubing over tapered end of discharge valve assembly so that it flares out. (If tubing is stiff from cold, dip end in hot water.)
4. Make sure tubing is forced onto fitting cone (tapered end) all the way to shoulder of the threads.
5. Push down on the coupling nut and turn until the threads are engaged. Tighten by hand until the tubing is held securely in place. **Caution:** Undue force will fracture the plastic fittings. **DO NOT USE PIPE WRENCH.**
6. Following same procedure, connect discharge tubing to injection check valve (if included).

C. ATTACHING THE SUCTION TUBING:

(If included)
Note: Suction and discharge tubing are the same material.

1. Cut the suction tubing to the length required. The foot valve (if included) should hang approximately 2" (5 cm) to 3" (7.6 cm) above the bottom of the chemical tank. Maximum recommended vertical suction lift 5 ft. (1.5 meters).
2. Following the same procedure as discharge tubing (See B) connect suction tubing to suction valve.
3. Connect the other end of the suction tubing to the foot valve and drop foot valve into the chemical tank.

D. PRIMING:

1. The chemical pump is pre-primed with water for your convenience. Set pump at maximum output and start pump. If chemical to be pumped cannot be mixed with water, loosen the four head screws and drain water out. Retighten the four head screws.
2. Loosen P/N 3044 Plug to prevent pressure build-up in pump head. Set pump at maximum output and start pump. **Caution:** Switch off pump as soon as suction tubing is filled with chemical.
3. Tighten P/N 3044 Plug to prevent squirting of chemical around plug. Set pump at desired output rate.

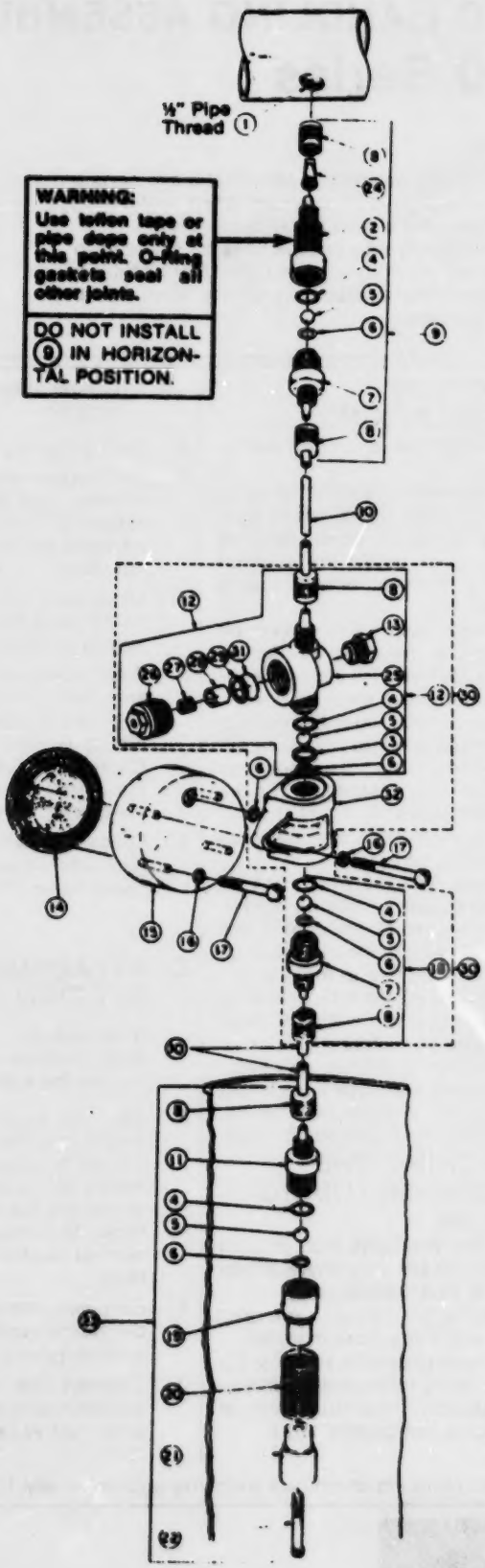
E. CLEANING HEAD AND VALVES: (Refer to exploded view on other side).

NOTE: IF VALVES ARE DIRTY OR NOT ASSEMBLED EXACTLY AS SHOWN IN EXPLODED VIEW, THE PUMP WILL NOT OPERATE.

1. Switch-off chemical pump. Release pressure from discharge line. Remove discharge and suction lines from pump. Plug discharge line so chemical will not drain back.
2. Unscrew discharge and suction valves from cartridge housing. Disassemble valves.
3. Clean valve balls, O-Rings, valve seats and head with detergent or soap solution.
4. Inspect O-Rings, balls and valve seats for pits or imperfections. O-Rings and balls must be perfectly smooth. If not, they must be replaced. Spare Parts Kit 500-67.
5. Assemble valves exactly as shown in exploded view.

* Based on pumping chemicals weighing approximately 10.5 lbs. per gallon (1.25 gm/cc).

Precision Control Products
400 Research Parkway, Meriden, Conn. 06450
(203) 237-5541 Telex: 96-2457 Cable: AMMAFOCO, Meriden


½" Pipe Thread (1)
WARNING:
Use teflon tape or pipe dope only at this point. O-Ring gaskets seal all other joints.
DO NOT INSTALL (9) IN HORIZONTAL POSITION.

Key No.	Part No.	Description	Quantity
1	—	Injection Point	—
2	2562	Connector	1
3	1048*	Washer**	1
4	1364*	O-Ring, Viton	4
5	1068*	Valve Ball	4
6	1280*	O-Ring, Teflon	5
7	2359	Seat, Valve	2
8	2360	Coupling Nut	5
9	2863-02	Injection Check Valve Assembly	1
10	3630	Tubing, Polyethylene	16 ft. (4.9 meters)
11	2361	Housing, Valve	1
12	2996-02	Anti-Syphon Valve Assembly	1
13	3644	Plug	1
14	4068	Piston	1
15	3366	Head	1
16	118	Washer	4
17	3368	Screw	4
18	2998-02	Suction Valve Assembly	1
19	2471-1	Seat, Valve	1
20	2472	Screen, Filter	1
21	2473	Retainer, Screen	1
22	2474*	Screw, Polypropylene	1
23	2999-02	Foot Valve & Strainer Assembly	1
24	2989*	Flapper—Viton	1
25	2983	Body, Anti-Syphon Valve	1
26	[illegible]	Plug, Anti-Syphon Valve	1
27	[illegible]*	Spring	1
28	[illegible]*	Spring Cap	1
29	3116*	Washer	1
30	[illegible]-37	Cartridge Valve Assembly	1
31	1340*	Diaphragm	1
32	2347	Cartridge Valve Housing	1

* Parts Included in Spare Parts Kit 800-67

** Not used on P/N 2983 anti-syphon valve body with spline

DERRICK MANUFACTURING CORPORATION • 590 Duke Road, Buffalo, N.Y. 14225 • Phone (716) 683-9010
Telex (DERRICK CHEE) 91-9110
address correspondence to P. O. Box 221, Buffalo, N. Y. 14225

September 24, 1984

Fenco Engineers Inc.
33 Young Street
Toronto Ontario
Canada M4E 1E7

ATTN: Mr. David Webster
SUBJ: PILOT PLANT
MULTIFEED WET SIZING SCREEN
DERRICK FILE 84F 0511

Gentlemen:

Regarding our phone discussion of September 21, this letter will confirm that the Model J24-36MS-1 Multifeed pilot screen (shown on drawing 3431-00-018) will be suitable for making an effective 100 mesh U.S. size separation on a total feed load of 1.83 MTPH of 0.5mm X 0 fine coal in a 50 IGPM feed slurry.

We appreciate your continued interest in our high speed screening equipment and will be pleased to discuss additional comments or questions you may have. Please do not hesitate to contact me.

Very truly yours,

DERRICK MANUFACTURING CORPORATION

James W Derrick

James W. Derrick
Vice President - Sales

/db
enc: Dwg 3431-00-018

LAVALIN A TOR

GOULDPUMP MSGA

NOV 2/84

ATTN D WEBSTER

RE DSS/CANMET

MOBILE UNIT
GOULDS T180-84

FURHTER TO OUR DISCUSSIONS REGARDING ITEM P5
ORIGINAL SELECTION WAS 1 1/2 X 2 - 8 JC BASED UPON 102 USGPM AT 40 FT TDH
MAX HEAD RECOMMENDED WITH THIS PUMP WOULD BE 72 FT AT 102 USGPM AND WOULD REQUIRE A 5 HP MOTOR (3.9 BHP AT DESIGN CONDITION USING 1.01 S.G.)

ESTIMATED PRICE INCREASE WOULD BE 91 DOLLARS FOR THE MOTOR (5 HP/1800RPM/TEFC/3/60/230 VOLTS/FRAME 184T) AND 248 DOLLARS INCREASE FOR THE VARIABLE SPEED CONTROLLER OVER THE PRICES QUOTED IN OUR QUOTATION AUG 3/84

FOR 100 FT TDH WE WOULD RECOMMEND THE 1 X 1 1/2 - 11 JC AT 1530 RPM, 7 1/2 HP MOTOR (6.6 BHP AT DESIGN CONDITION 102 USGPM, 1.01 S.G.)

PRICE INCREASE FOR MOTOR (OVER 1 1/2HP) IS 148 DOLLARS. (7 1/2 HP/1800RPM/FRAME 213T) AND 3172 DOLLARS INCREASE FOR THE VARIABLE SPEED CONTROLLER OVER THE AUG 3/84 PRICES QUOTED

THE PUMP PRICE WOULD INCREASE BY 86 DOLLARS. NOTE THAT THE BIG DIFFERENCE IS THE VARIABLE SPEED CONTROLLER PRICE AT WHEN USING 7 1/2HP MOTOR

ONCE YOU HAVE HAD A CHANCE TO CONSIDER THESE ALTERNATIVES WE WOULD BE PLEASED TO REVISE OUR AUG 3/84 QUOTATION IN ACCORDANCE WITH YOUR REQUIREMENTS

REGARDS D WILSON

GOULDPUMP MSGA

LAVALIN A TOR
M

RECEIVED AUG - 8 1984

GOULDS PUMPS
CANADA INC.

6199 Shawson Drive
Mississauga, Ontario
L5T 1E5
Tel.: (416) 677-6530
Telex: 06-983585

August 3, 1984

Fenco Engineers Inc.,
33 Yonge Street,
Toronto, Ontario.
M5E 1E7

Attention: Mr. David Webster

Subject: DSS/Canmet
Mobile Unit
Goulds Ref: T180-84

Gentlemen:

We are pleased to submit the attached proposal, complete with enclosures as per your request.

Goulds Pumps Canada Inc., Standard Terms & Conditions of Sale, Schedule "F" attached will apply.

We look forward to the opportunity of working with you further on this project.

Yours truly,

David R. Wilson,
Regional Sales Manager.

DRW/bl

cc: G.W. Banks - Toronto

Enclosures: Bull€ten 201.1
Bull€ten 201.1 Supp.
Performance Curves CDS D-9712, CDS D-9713
Toshiba VF Pack-P Bull€ten

FENCO ENGINEERS

Goulds Ref: T180-84

ITEM	CAPACITY IGPM(USGPM)	TDH FT	S.G.	PUMP SPEED RPM	PUMP MODEL	PRICE
P1	50 (60)	10	1.04	840	1X1½-8 JC	$ 3,304.00
P2	50 (60)	10	1.04	840	1X1½-8 JC	$ 3,304.00
P3	50 (60) 18 (22)	10 10	1.04 1.05	840 730	1X1½-8 JC	$ 3,304.00
P4	5 (6)	10	1.05	730	1X1½-8 JC	$ 3,304.00
P5	85 to 44 (102 to 53)	~~40~~ 100	1.01	1300 to 1250	~~1½X2-8 JC~~ 1X1½-11	$ 3,399.00
P6	50 (60)	10	1.04	840	1X1½-8 JC	$ 3,304.00
P7	18 (22)	10	1.06	730	1X1½-8 JC	$ 3,304.00

NOTES

1) ABOVE PRICE INCLUDES PUMP IN CAST IRON CONSTRUCTION COMPLETE WITH EXPELLER SEAL, V-BELT DRIVE AND GUARD, OVERHEAD MOTOR MOUNTING SUPPORT AND 1½ HP/1800 RPM/ TEFC MOTOR 3PH/60HZ/230 VOLTS, FRAME 145T. TOTAL WEIGHT APPROX. 450 LBS. PER UNIT. ESTIMATED SHIPMENT: 10 TO 12 WEEKS FROM RELEASE FOR MANUFACTURE.

2) EXTRA PRICE FOR VARIABLE SPEED CONTROLLER PER THE ENCLOSED LITERATURE (TOSHIBA VF PACK-P TRANSISTOR INVERTER) $958.00 EACH.

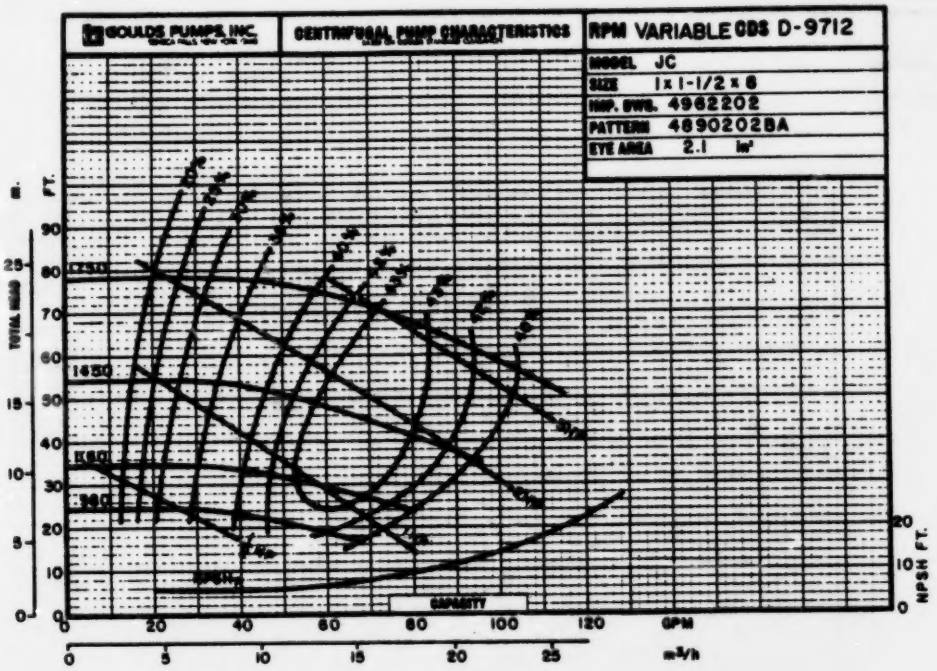
3) ALL PRICES ARE IN CANADIAN FUNDS, F.O.B. CAMBRIDGE, ONTARIO, ALL TAXES EXTRA.

Customer _____ Inquiry No. _____ Date _____

Service _____ Item No. _____ P.O. No. _____ Date _____

F.O. No. _____; _____ GPM; _____ TDH; _____ RPM; _____ % Eff.; CDS No. _____

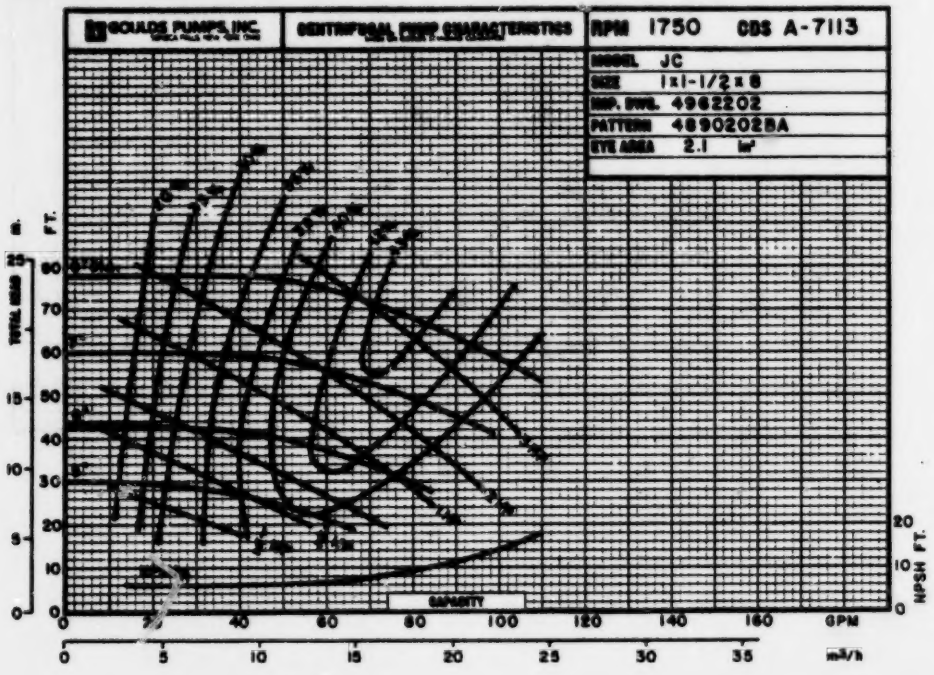
Variable Speed



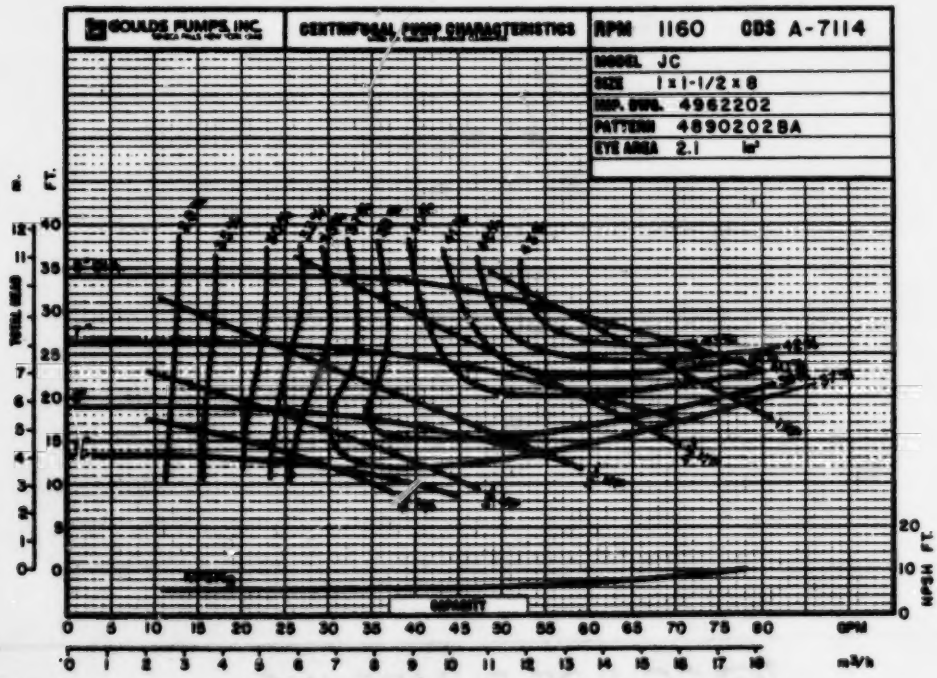
Model JC
Performance Curves

201.19
January 1, 1983
(New)

Customer _____ Inquiry No. _____ Date _____
Service _____ Item No. _____ P.O. No. _____ Date _____
F.O. No. _____ ; _____ GPM; _____ TDH; _____ RPM; _____ % Eff.; CDS No. _____



1750 RPM



1160 RPM

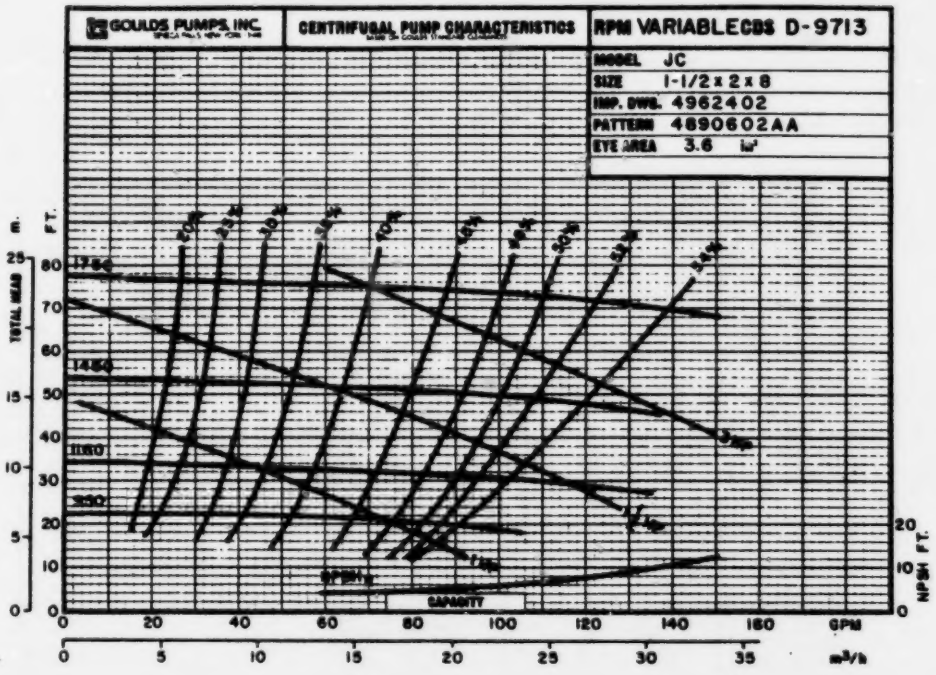
(over)

Customer _____ Inquiry No. _____ Date _____

Service _____ Item No. _____ P.O. No. _____ Date _____

F.O. No. _____; _____ GPM; _____ TDH; _____ RPM; _____ % Eff.; CDS No. _____

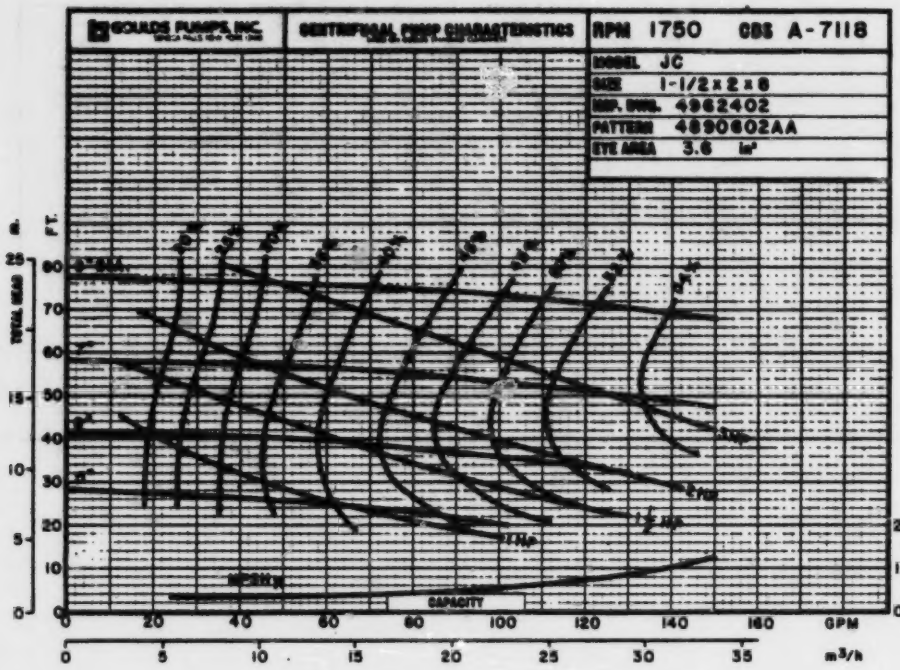
Variable Speed



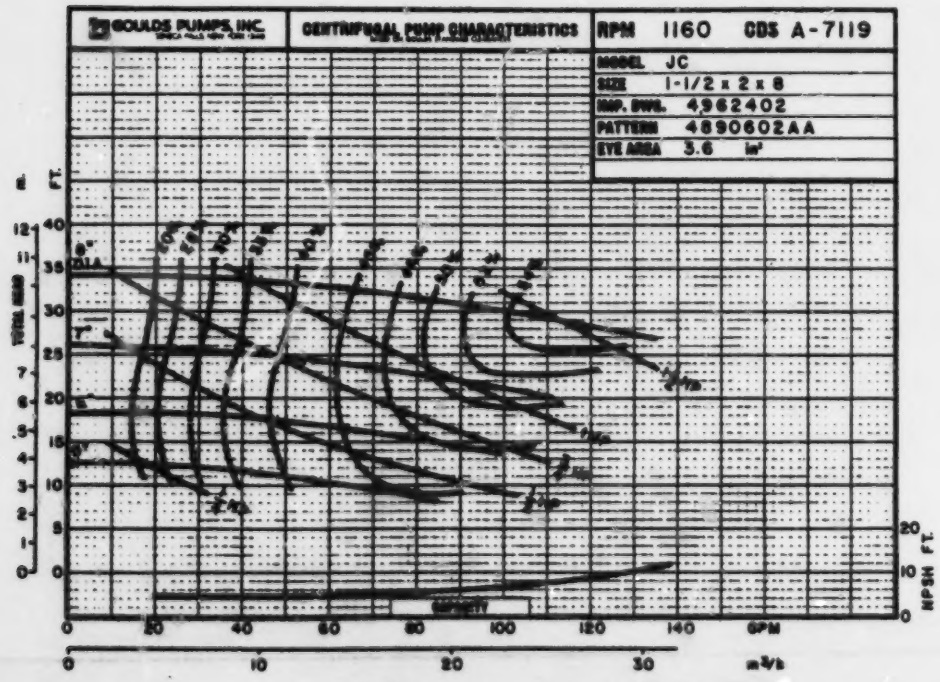
Model JC
Performance Curves

201.23
January 1, 1983
(New)

Customer _____ Inquiry No. _____ Date _____
Service _____ Item No. _____ P.O. No. _____ Date _____
F.O. No. _____; _____ GPM; _____ TDH; _____ RPM; _____ % Eff.; CDS No. _____



1750 RPM



1160 RPM

(over)

SCHEDULE F
STANDARD TERMS AND CONDITIONS
GOULDS PUMPS, CANADA INC. CAMBRIDGE, ONTARIO, CANADA
All Sales and Transactions with Goulds Pumps, Canada Inc., are subject to its Standard Terms and Conditions

1. Warranty: The Company warrants that its pumps, when properly installed and cared for as stated in the appropriate instruction manual issued by the Company, will operate in accordance with its proposal.

Goulds Pumps are warranted to be made of first-class material, and in a skillful and workmanlike manner. They are additionally warranted against any defective material or workmanship and any part proven defective within one year from the date of shipment, after inspection by and to the satisfaction of the Company, will be replaced free of charge F.O.B. Shipping Point, on return of such defective part to the Company, transportation charges prepaid. No parts, however, shall be returned without the express authority of the Company so to do.

There are no warranties or conditions, express, implied, statutory or otherwise, except such warranties as are definitely set forth herein. The Company shall not be liable for damage or wear to pump caused by abnormal conditions, vibration, failure to properly prime or to operate pump without flow or caused by corrosives, abrasives or foreign objects. No obligations other than those herein set forth shall be binding upon the Company. No warranties apply to other than the original user.

The Company shall in no event be held liable for damages or delay caused by defective material and no allowance will be made for repairs or alterations, unless made by its written consent or approval. In the event the pumps are altered or repaired by others without prior written approval by the Company all warranties are void. Equipment and accessories not manufactured by the Company are warranted only to the extent of and by the original manufacturer's warranty.

Under no circumstances shall the Company be held liable for any consequential or other damages, losses or expenses arising from installation, use, or any other causes, regardless of advices or recommendations that may have been rendered concerning such installation or use of its products, nor shall the Company be liable for penalties of any description.

2. Shipment: Promised shipping dates are approximate, and are from point of manufacture. Such dates are estimated from (a) the date of receipt of order with complete manufacturing information at Company's factory, and (b) the date of entry of such order by the Company. Shipping dates are subject to revision at the time of the entry of order and the shipping schedule then given is approximate and subject to any action Company must take in connection with priorities or other orders or regulations issued by a government, or any department thereof.

The Company will not be liable for loss, damage, detention, or delay in manufacture or delivery or necessity to substitute materials, resulting from causes beyond its reasonable control, including but not limited to casting failures, war, fire, strikes, lockouts, or other labor difficulties, civil or military authority, insurrection or riot, embargoes, car or ship shortages, acts of governments, wrecks or delays in transportation, including any delays caused by inability to obtain necessary labor, materials or manufacturing facilities due to such causes, or from action taken by the Company in connection with priorities or preference orders or other production permits issued by a Government or any department thereof, or from delay in obtaining or failure to obtain manufacturing, financing, export or other licenses required by a Government or any department thereof; or in any event for consequential damages.

Acceptance of material by common carrier constitutes a waiver of any claim against the Company for delay or damage in transit, or for lost goods.

When quotation includes equipment not of Company's manufacture, Company's promise of shipment is based on manufacturer's promise to Company and shipment is contingent on the fulfillment of their promise.

3. Prices: All prices are subject to change without notice and are subject to any increase which may be in effect on the date of shipment of the goods, such increase, if any, to be within any applicable government regulations. Prices are F.O.B. Shipping Point, unless otherwise specified. When price includes transportation and other charges pertaining to the shipment of the goods, any increase in transportation rates and other charges will be for the account of the purchaser. There will be an extra charge for any test other than that which may be normally run by the Company, or for any test performed to suit the convenience of the purchaser.

4. Terms of Payment: Terms and conditions of payment will be shown on invoices rendered by the Company at time of shipment or as may be otherwise stated in writing by an officer of the Company.

5. Orders: All illustrations and specifications are descriptive and are not intended as warranties. The acceptance of all orders taken by the Company's sales representatives or branches is subject to approval by Company's office at Cambridge Ontario Canada.

6. Cancellation of Orders: Orders once placed with and accepted by Company can be cancelled only with Company's consent and upon terms that will indemnify Company against loss.

(a) Company may forthwith cancel the order or contract without recourse:
- (i) if conditions are such that shipment from Company's factory may be delayed beyond the date estimated at the time of entry of order or contract;
- (ii) if the Purchaser is in default with the Company on this or any other order or contract;
- (iii) if Purchaser is or becomes insolvent, or if at any time Company is not fully satisfied with the credit of Purchaser, it may at any time after the order has been entered, or during the manufacturing period, or at the time the goods are ready for shipment, require payment in advance of shipping regardless of original terms, or if after shipment has been made and before actual delivery and acceptance at destination, (regardless of F.O.B. point), it may recall the shipment and cancel this and any and all other orders and contracts which may be outstanding, and shall be entitled to receive reimbursement for its reasonable and proper cancellation charges.
- (iv) if the order or contract is for the direct account of one of its sales representatives, distributors or dealers, and Company terminates or alters such relationship.

(b) The Company shall have at all times a right of set-off as to any and all accounts between it and Purchaser.

7. Claims: No claims for allowances will be entertained unless presented immediately on receipt of goods; nor will Company be held responsible for breakage or shortage after goods are delivered to and accepted by the common carrier.

8. Equipment Returned: Goods can be returned for credit only after receiving Company's authorization and shipping instructions. Consignor's name and address must be plainly written on the shipping tag.

9. Taxes: All Federal, Provincial, Local and Municipal taxes now in effect or hereafter enacted that are applicable to this transaction shall be paid for the account of the Purchaser, and if paid or required to be paid by the Company, the amount thereof shall be added to and become a part of the price payable by the Purchaser hereunder.

10. Minimum Charge: A minimum charge of $60.00 will be made in the case of any order, the items on which at the net prices total less than this amount.

11. General: All sales and transactions are subject to Company's Standard Terms and Conditions, and they shall prevail in the event of any conflict or variance with those of the Purchaser's, unless otherwise agreed to in writing.

All previous agreements, either written or oral, which are subject matter hereof, are hereby cancelled.

Stenographic or clerical errors are subject to correction.

If this transaction involves EXPORT, the following additional terms and conditions shall apply:

12. Packing: Equipment will be packed, boxed or crated in accordance with the Company's standard commercial practice, for underdeck export shipment, unless otherwise agreed.

13. Payment: Unless otherwise specified in writing, payment shall be made by irrevocable letter of credit in form acceptable to Company, confirmed by a bank acceptable to Company, and providing for payment in full in Canadian dollars in Ontario against presentation of Canadian inland shipping documents and invoices, such letter of credit to be established prior to Company's acceptance of the order. The letter of credit shall provide also that in the event Company is, for any reason beyond its control, prevented from making shipment from Company's factory or delivery at the port of embarkation, a certificate of manufacture of the whole or any part of the goods shall constitute delivery of such whole or any part of the goods and payment in full of any and all drafts drawn against the letter of credit for the goods so "delivered" shall be made upon presentation of such certificate of manufacture in lieu of Canadian inland shipping documents. In the event that Company is prevented by law, or otherwise, from making shipment from Company's factory or delivery at port of embarkation of the goods or any part thereof, on completion of manufacture, Company reserves the right to place the goods in storage for the purchaser's account and risk. Any charges incurred in this connection will be for the account of the purchaser at cost and will be payable upon demand.

14. Company as Agent: If Company makes or arranges for ocean shipment, Company shall act as agent for the purchaser and reserves the right to procure full insurance coverage, including war risk insurance, at the expense of the purchaser. All expenses incurred in this connection will be payable upon demand to the Company.

If Company applies for or secures manufacturing, financing, exporting or other licenses required by the Government, or any department thereof, Company shall make such applications or secure such licenses solely as agent for the purchaser, and assumes no responsibility therefor.

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION
235 KING ST. E., KITCHENER, ONT. N2G 4N6 · (519) 578-6400 · TELEX: 069-55324

PROPOSAL TO

FENCO ENGINEERS LTD.
33 Yonge Street
Toronto, Ontario
M5E 1E7

- FOR -

FLOTATION EQUIPMENT

YOUR FILE NO.	:	Project 42022
OUR QUOTATION NO.	:	84/3255
DATED	:	August 9, 1984

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION
235 KING ST. E., KITCHENER, ONT. N2G 4N8 · (519) 578-6400 · TELEX: 069-55324

August 9, 1984

Fenco Engineers Ltd.
33 Yonge Street
Toronto, Ontario
M5E 1E7

Attention: Mr. David Webster

Subject: Project No. 42022
Mobile Fine Coal Cleaning Plant
Flotation Cells
Our Quotation No. 84/3255

Gentlemen:

Further to your recent enquiry for a budget price estimate on Denver Flotation Machines, we are pleased to submit our firm quotation in accordance with your request.

The flotation equipment offered is illustrated in the attached latest bulletins as well as the attached technical specifications, data sheets, and respective drawings.

The Denver Cell-to-Cell Flotation Machines quoted are designed for multi-stage operations which require a high degree of selectivity. Short-circuiting is eliminated by feeding pulp directly into the impeller in each cell and recirculating a portion of the pulp through recirculation ports to give additional pulp mixing. Other features incorporated in the design include cell aeration which eliminates the need for additional blowers, polyurethane wear parts, individual manual cell volume control with sand relief openings and a mechanical design that permits modification of cell flow for maximum flexibility.

The Denver DR Flotation Machines quoted include design features that have been substantially improved over these last few years to provide our Canadian customers with operating features that are selected to satisfy their unique process requirements. They include:

(a) Single cell V-belt drives instead of dual drives which, in addition to greater internal baffling between cells, results in improved recovery from a better distribution of flow.

(b) Flanged and bolted impeller to shaft attachment instead of tapered key design.

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CONTINUATION OF LETTER TO
Fenco Engineers Ltd.

ATTENTION: Mr. David Webster

(c) Polyurethane impellers and diffusers for greater wear resistance.

(d) Separate gear motor froth paddle drives.

Prices quoted and other commercial details are as shown in the attached Quotation Summary and Equipment Price Breakdown.

With the attached Proposal we trust we have attached all the information you require at this time. However, we would welcome the opportunity to discuss our Proposal with you at your convenience and assure you that your valued business would be very much appreciated and would receive our best attention.

Yours very truly

JOY Manufacturing Company (Canada) Limited
DENVER DIVISION

G. Panthel
Marketing Manager

GP:lt

Encls.

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION

I N D E X

PAGE NO.	SUBJECT
1	Quotation Summary
2 - 5	Price Quotation Breakdown
6	Price Adjustment Clause
7	Proposed Terms of Payment
8	General Terms and Conditions (81.A)
9	Paint Spec's (Red)

ENCLOSURES:

Bulletin No.: F01-B278
F01-B86C

Drawings No.: M0-76185-A-1
M0-74714-B-0
M0-74160-A-0
M0-76242-A-0

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION

QUOTATION SUMMARY

01. Equipment Price $113,825.00
(excluding taxes, packing and freight charges)

02. Fees, Duty, Brokerage And Other Separate Charges ...$ N/A
(If applicable - please itemize)

03. Federal Sales Tax @ % .....$ Extra

04. Provincial Sales Tax @ % .....$ Extra

05. Sub-Total Value FOB Factory (Shipping Point) $113,825.00

06. Estimated Freight Charges (F.O.B. JOBSITE).....$ 1,950.00

07. Total Value $115,775.00

08. Terms of Payment See attached Proposal

09. Warranty 18 Months From Shipment/ 12 Months From Start-Up

10. Submit Data For Review 4 Weeks From Award of Purchase Order

11. Deliver Equipment 16 Weeks From Receipt of Reviewed Drawings

12. Shipping Point Kitchener, Ontario
F.O.B. Point Edmonton, Alberta

13. Carrier (proposed - on which estimated freight charges are based)
Reimer Transport

14. Total Weight: Gross 5,700 Kg. Net 5,650 Kg.
Heaviest Section _____ Total Shipping Volume _____

15. This offer shall be binding upon the Bidder until Oct. 31/84 and may be accepted any time on or prior to this date.

16. Prices quoted to remain firm without escalation if order placed before Oct. 31/84 and shipment before April/85 .

17. Prices will be escalated for shipments after April/85 in accordance with the attached Price Adjustment Clause.

18. This offer is subject to the attached Commercial Terms.

Date August 9, 1984 Bidder JOY Mfg. Co. (Cda) Ltd.
DENVER DIVISION

Signature

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION

PRICE QUOTATION BREAKDOWN

FLOTATION MACHINES

ITEM 1.1 - Five Cells No. 15 Cell-to-Cell (12 cu. ft./cell) DENVER Flotation Machine including double overflow tank constructed of 3/16" thick mild steel plate with 3/16" thick abrasion resistant steel bottom liner. Each cell partition includes a fabricated steel weir with adjustable pulp level weir bar control. Machine is furnished with a combination box type air header and superstructure for support of mechanism and motor. Froth overflow at each cell provides for 3" froth adjustment by addition of steel bars. The froth paddle assembly for each overflow lip consists of half horsepower 28 output RPM 3 Phase 60 Hz ~~575~~ 480 volts totally enclosed fan cooled gear motor, direct coupled to double bladed PVC paddles with grease lubricated UHMW paddle shaft split bearing blocks. The mechanism consists of a cast iron spindle bearing housing and anti-friction spherical roller bearings rated plus 100,000 hours, dust cap and grease seals with integral flange, mounted to a suspended type standpipe and hood including provision of feed and return feed pipes and/or plug plates, 2-3/16" diameter cold rolled steel shaft, a 12" diameter polyurethane covered cast iron skeleton six bladed receded disc impeller and matching polyurethane diffuser bolted to the hood. Also included are V-belt drives and drive guards to operate each mechanism at 550 RPM from 3 HP 1800 RPM single cell drive motor. Concentrate launders are constructed of 1/8" thick low density polyethylene forming a sloping round trough bottom hung from steel launder support brackets. Launder slope, geometric shape and location of the victaulic discharge nipple to suit customer's requirements.

Total Approximate Shipping Weight.....2,360 Kg.

TOTAL PRICE.....$34,800.00

PRICE QUOTATION BREAKDOWN

FLOTATION MACHINES

ITEM 2.1 - Two banks of five cells No. 8 Cell-to-Cell (3 cu. ft./cell) DENVER Flotation Machines including double overflow tank constructed of 10 gauge thick mild steel plate with 10 gauge thick abrasion resistant steel bottom liner. Each cell partition includes a fabricated steel weir with adjustable pulp level weir bar control. Machine is furnished with a combination box type air header and superstructure for support of mechanism and motor. Froth overflow at each cell provides for 3" froth adjustment by addition of steel bars. The froth paddle assembly for each overflow lip consists of half horsepower 28 output RPM 3 Phase 60 Hz 575 volts totally enclosed fan cooled gear motor, direct coupled to double bladed PVC paddles with grease lubricated UHMW paddle shaft split bearing blocks. The mechanism consists of a cast iron spindle bearing housing and anti-friction spherical roller bearings rated plus 100,000 hours, dust cap and grease seals with integral flange, mounted to a suspended type standpipe and hood including provision of feed and return feed pipes and/or plug plates, 1-7/16" diameter cold rolled steel shaft, a 8" diameter polyurethane covered cast iron skeleton six bladed receded disc impeller and matching polyurethane diffuser bolted to the hood. Also included are V-belt drives and drive guards to operate each mechanism at 825 RPM from 1½ HP 1800 RPM single cell drive motor. Concentrate launders are constructed of 10 gauge steel sheet forming a sloping round trough bottom hung from steel launder support brackets. Launder slope, geometric shape and location of the victaulic discharge nipple to suit customer's requirements.

Total Approximate Shipping Weight.....1,670 Kg.

TOTAL PRICE.....$43,200.00

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION

PRICE QUOTATION BREAKDOWN

FLOTATION MACHINES

ITEM 3.1 - Two banks of five cell No. 8 DR (3 cu. ft./cell) DENVER Flotation Machines each bank including double overflow tanks with feed and discharge boxes, mechanisms consisting of a cast iron spindle bearing housing with anti-friction spherical roller bearings rated plus 100,000 hours, dust cap and grease seals with integral flange, mounted to a suspended type standpipe with combination pulp recirculation well and air pipe including 1-7/16" diameter cold rolled steel solid shaft with flanged attachment to a 8" diameter six bladed pressure molded polyurethane covered cast iron skeleton receded disc impeller and matching polyurethane covered diffuser bolted to the standpipe. Also included are V-belt drives and drive guards to operate mechanisms at 595 RPM from 1½ HP 1800 RPM single cell drive motors. Tank is constructed of 10 gauge mild steel plate with 10 gauge thick abrasion resistant steel bottom liner. Intermediate cell partition baffles include a pulp flow-through opening sized in accordance with individual design flow requirements. Discharge boxes are constructed of 10 gauge mild steel and include one level control dart valve assembly for either manual or automatic level control. Each cell includes a manual air valve control consisting of a 1" gate valve to control auxillary air to each cell of 12 cfm maximum volume and 10 oz/sq.in. aerated pressure. Each overflow lip includes a froth paddle assembly consisting of 1/3 HP 29 RPM 3 Phase 60 Hz 575 volts totally enclosed fan cooled gear motor direct coupled to a pipe shaft with double-bladed PVC paddles and grease lubricated UHMW polyethylene paddle shaft bearing blocks. Concentrate launders for each froth overflow lip are constructed of 10 gauge steel sheet with sloping round trough bottom and victaulic pipe discharge nipple. Launder slope, geometric shape and location of discharge nipple to suit customer's requirements.

Total Approximate Shipping Weight.....1,460 Kg.

TOTAL PRICE.....$32,800.00

PRICE QUOTATION BREAKDOWN

BLOWER

ITEM 3.2 - One Spencer Turbine Model 20102A Blower Type S0H rated 10 oz./sq. in. pressure at 120 ICFM volume with 4" diameter discharge blast gate, 4" inlet air filter/silencer and 1½ HP 3500 RPM 3 Phase 60 cycle 575 volt totally enclosed fan cooled motor.

Approximate Shipping Weight.....160 Kg.

TOTAL PRICE.....$3,025.00

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION

PRICE ADJUSTMENT CLAUSE

The prices quoted in this Proposal are based on the Company's current costs. Escalation as defined on adjustment clauses A & B shall apply. October 1984 shall be taken as the base month for material, production, labour and freight.

A. Material Price Adjustment Clause

A.1 For the purpose of adjustment, the proportion of the equipment price representing material is accepted as 55%.

A.2 Such adjustment will be based upon the Industry Selling Price Index-Iron and Steel Mills, Code 12-2910, as given in "Prices and Price Indexes" (Statistics Canada Catalog 62-011, Table 1). An average of such index numbers for the period during which the material is being delivered to the Company will be computed and the percentage increases or decreases will be obtained by a comparison with such index number for the base month. The adjustment for changes in material prices will be obtained by applying such percentage of increase or decrease to the amounts representing material as stated in A.1.

B. Production Labour Adjustment Clause

B.1 For the purpose of adjustment, the proportion of the equipment price representing production labour is accepted as 45%.

B.2 Such adjustment will be based upon the "Average Hourly Earnings, (including overtime) employees paid by the hour", Metal Fabricating Industries, S.I.C. 301-309, for the Province of Ontario as given in "Hours and Hourly Earnings by Industry, Provinces", (Statistics Canada Catalogue 72-002, Table 12). The arithmetic average of such published monthly hourly earnings for the period during which the equipment is being fabricated will be computed and the percentage increase or decrease will be obtained by a comparison with such hourly earnings for the "Base Index Value". The adjustment for changes in production labour rates will be obtained by applying such percentage of increase or decrease to the amount representing production labour as stated in B.1.

JOY MANUFACTURING COMPANY (CANADA) LIMITED
DENVER DIVISION

PROPOSED TERMS OF PAYMENT

10% - Upon Submission of Certified Drawings

40% - 12 Weeks After Order Placement

50% - Net 30 Days Following Shipment

11.1 GUARANTEES

Material and Workmanship Warranty

The Company will replace or repair without charge FOB original point of shipment, parts found to be defective in material or workmanship under normal and proper use (wear and tear from abrasion and/or corrosion excepted) within twelve (12) months of the date the installation commences to operate but no later than eighteen (18) months from the date the equipment is ready for shipment. The Purchaser shall give the Company prompt written notice of such defects.

The responsibility of the Company under this guarantee is limited to the cost of the defective parts and shall not include any disassembly and/or re-installation costs. The Purchaser shall give all reasonable assistance free of charge to any corrective efforts by the Company.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE.

11.2 RESPONSIBILITY

Title to the material and equipment hereunder shall pass to the Purchaser upon delivery to the carrier at point of shipment except when the Company is also erecting the material or equipment in which case title shall pass to the Purchaser upon completion of erection. The Purchaser thereafter shall assume full responsibility for any loss of or damage to such material or equipment except for damage resulting from negligence of the Company.

The Company shall not be responsible for any delay in performance or for any failure to perform caused by acts of God, fires, strikes, labour or material shortages, failure of material procurers, vendors, fabricators and equipment suppliers to deliver on schedule or any other cause over which the Company has no control.

In no event shall the Company incur liability for:

a) Indirect, incidental, consequential or special damages of any character, including, but not limited to, loss of profits and revenues resulting from plant shut-down or non-operation of equipment, lost production, increased expense of operation, property damage, damages suffered by Purchaser or others from loss of use of productive facilities and loss or harm to third parties.

b) Defects in equipment procured hereby caused by corrosion or abrasion.

c) Loss or harm caused by sole negligence of Purchaser.

d) Loss of or damage to equipment furnished by the Company after transfer of care, custody or control of that equipment from the Company.

e) Compliance with air pollution laws, statutes, regulations and ordinances.

Notwithstanding any provisions of this contract, express or implied, the Company shall have:

a) An equitable adjustment in the contract price for delays caused by Purchaser.

b) A reasonable extension in periods of performance when the Company is delayed by cause over which the Company has no reasonable control.

c) Full compensation for all costs incurred and a reasonable allowance for profit if this contract is cancelled.

d) The Company's sole responsibility and the Purchaser's sole and exclusive remedy (for breach of any covenant, warranty or guarantee contained herein including, but not limited to, a breach of any of the provisions of the performance guarantee hereof or a fundamental breach hereof or for any negligence whatsoever on the part of any person for whose acts it is in law responsible) will be limited at the Company's sole option to repair, replacement or a cash settlement equal to the value of the defective part or parts.

This shall be limited to the original purchase price of the equipment.

11.3 INSURANCE

a) The Company shall maintain for its employees such Workmen's Compensation Insurance and/or Employer's Liability Insurance as is required by law.

b) The Company shall carry Comprehensive Public Liability and Property Damage insurance for the following limits of liability:

Bodily Injury	$ 500,000. per person $1,000,000. per occurrence
Property Damage	$ 500,000. per occurrence $ 500,000. aggregate

11.4 PATENT INDEMNIFICATION

The Company agrees that it will indemnify the Purchaser for all damages or costs resulting from any suit or damage alleging infringement of any Canadian patent claims regarding the structure of the apparatus or any part thereof furnished by the Company under this proposal, if the Company is notified promptly in writing of such suit or demand, either by procuring for the Purchaser the right to continue using the apparatus or part thereof furnished by the company or by replacing same with non-infringing apparatus; or by modifying same so that it becomes non-infringing; or by removing the alleged infringing apparatus and refunding the reasonable portion of the purchase price attributable thereto. On any apparatus or part thereof made to the Purchaser's design or the design of which has been modified by the Purchaser, this indemnification clause does not apply. The Company's sole responsibility and the Purchaser's exclusive remedy for any such suit or demand shall be as set forth in this paragraph.

11.5 DELIVERY SCHEDULE

The Company will make every effort to ship the equipment in accordance with the delivery schedule noted in the introduction of this proposal. The Purchaser, if unable to receive the material shall promptly advise the Company to what point delivery may be made, and shall assume storage charges and additional transportation charges involved and shall assume the risk of all loss or damage while the material is in storage and/or transportation to and from storage.

11.6 ACCEPTANCE

The Purchaser agrees to accept the installation and thereby release the Company from all obligations to the Purchaser except those provided under "Material and Workmanship" upon completion of the installation proposed herein.

11.7 EXECUTION

This proposal is valid for acceptance for 60 days unless otherwise stated herein and is subject to revision from the date thereof. There are no agreements nor representations verbal or otherwise, other than as contained in this contract. This proposal shall become a contract between the parties hereto and their successors and assigns when accepted by the Purchaser and executed by an officer of the Company at its home office, Kitchener, Ontario (it being agreed that such contract shall be subject to the laws of the Province of Ontario).

PRECIPITATION DIVISION JOY MFG. CO. (CANADA) LTD., MONTREAL	PAINT SPEC'S (RED)

1. SURFACE PREPARATION:

   a. SURFACES TO BE PAINTED SHALL BE PREPARED IN ACCORDANCE WITH SSPC - SP3-63 POWER TOOL CLEANING.

   b. ALL MACHINED SURFACES SHALL BE PROTECTED WITH ONE SHOP COAT OF RUST BAN #392 IMPERIAL OIL OR EQUAL.

2. PAINT:

   a. ALL STEEL SURFACES SHALL BE PAINTED WITH 2 MILS OF RED OXIDE PRIMER NO. 2300 ALPINE PAINT OR EQUAL UNLESS OTHERWISE DESIGNATED ON THE PURCHASE ORDER, ON BILLS OF MATERIAL OR DRAWINGS.

   b. TANKS WITH WELDED IN LINERS NEED NOT BE PAINTED UNTIL AFTER LINERS ARE INSTALLED.

THIS DRAWING IS FURNISHED FOR THE SOLE USE OF THE RECIPIENT AND THE ACCEPTANCE OF SAME CONSTITUTES AN AGREEMENT THAT IT WILL NOT BE PUBLISHED, REPRODUCED OR GIVEN TO ANY OTHER PARTY WITHOUT OUR PERMISSION. UNLESS FURNISHED TO RECIPIENT UNDER CONTRACT PROVISIONS IT SHALL REMAIN OUR PROPERTY, SUBJECT TO RETURN UPON REQUEST. STRUCTURES, EQUIPMENTS, PARTS OR OTHER ITEMS ON THIS DRAWING ARE TO BE FURNISHED BY US ONLY IF SPECIALLY SO STATED HEREON OR IN A WRITTEN AGREEMENT BY US REFERRING HERETO.

STANDARD	DRAWN BY N.F. Avery DATE June 16/80 CHECKED BY [illegible] DATE 6-16-80 APPROVED BY	MOS-71599-L	0

NWC1 TRANSTEX 13

SECTION 4

PROCESS EQUIPMENT SPECIFICATIONS

4.0 PROCESS EQUIPMENT SPECIFICATIONS

4.1 General

The process equipment incorporated into the final design of the mobile is the same as that specified in Section 4 of the Phase II report with the exceptions detailed below. A proprietary equipment list is included herein together with copies of the manufacturers/suppliers quotations.

4.2 Froth Pumps

Two froth pumps are required. Froth Pump No. 1 for flotation cells Bank No. 1 and Froth Pump No. 2 for flotation cells Bank No. 2. Both pumps are to be identical.

Duty - Each unit to be capable of pumping coal froth concentrate at a flow rate of 20 I gpm (5.5 m^3/h) containing 25% - 30% solids by weight of particle size 0.5 mm x 0. The pumps will have a T.D.H. of approximately 10 feet (3 m).

Equipment - Two Sala SPVC-232-50 vertical froth pump and sump integrated unit. Pumps to have neoprene lined wear parts; alloy steel shaft and be complete with V-belt drive; adjustable motor base; motor and guard. The sump will be conical, fabricated from mild steel and specially designed to suit piping connections and structure as shown on Fenco drawing No. 42022-GA-01 .

4.3 Froth Reagent Pumps

Because the chemical addition is a vital part of flotation, the system has the flexibility to allow the operator to fully study the effect of chemical type, dosage rate and points of addition.

Both a frother and collector addition are included plus, as requested by CRL, a promoter. A tank for each of these chemicals is on board, each with its own independent metering pumps.

Two other factors affecting the design are the addition rate and addition points. For the collector/promoters these will be added to the conditioning tanks. The frother shall be added directly into the cell mechanisms; the first three mechanisms in each bank being considered sufficient.

The flotation reagent addition system included on the trailer for chemical dosage of the froth cells has the capability of being integrated into the control circuitry presently being developed by C.R.L. In terms of Fenco design consideration the metering pumps have auto/manual feed rate controls.

A total of thirteen (13) froth reagent pumps are required.

Duty

Chemical Type	Typical	Flow Rate US gphr	Number of Pumps
Collector	Kerosene	0.57 - 0.007	2
Promoter	Accoal 4433	0.57 - 0.007	2
Frother	MIBC	0.14 - 0.002	9

Equipment - 13 AMF Cuno precision metering pumps. Pumps will be drivers only with remote auto/manual Sentrol control.

Chemical Type	Pump Model	Sentrol Control	No. Off
Collector	10671-96R	5172-03	2
Promoter	10671-96R	5172-03	2
Frother	10671-92R	5172-03	9

All pumps will have similar materials of construction

Fittings and Head: PVC
Valve Balls : Ceramic
'O' Rings : Teflon
Diaton : Teflon

Table 4-1 shows the flotation reagent metering pump utilization.

TABLE 4-1

FLOTATION REAGENT METERING PUMPS

Pump No.	Discharge Point	Chemical	Process Options						
			1	2	3	4	5	6	7
RP1	Conditioner 1	Collection	✓	✓	✓	✓	✓	/	-
RP2	Conditioner 2	Collection	✓	✓	-	-	-	-	-
RP3	Conditioner 1	Promoter	✓	✓	✓	✓	✓	✓	-
RP4	Conditioner 2	Promoter	✓	✓	-	-	-	-	-
RP5	Cell Bank 1 Mech. 1	Frother	✓	✓	✓	✓	✓	✓	-
RP6	Cell Bank 1 Mech. 2	Frother	✓	✓	✓	✓	✓	✓	-
RP7	Cell Bank 1 Mech. 3	Frother	✓	✓	✓	✓	✓	✓	-
RP8	Cell Bank 2a Mech. 1	Frother	✓	✓	-	-	-	-	-
RP9	Cell Bank 2a Mech. 2	Frother	✓	✓	-	-	-	-	-
RP10	Cell Bank 2a Mech. 3	Frother	✓	✓	-	-	-	-	-
RP11	Cell Bank 2b Mech. 1	Frother	✓	-	-	-	-	-	-
RP12	Cell Bank 2b Mech. 2	Frother	✓	-	-	-	-	-	-
RP13	Cell Bank 2b Mech. 3	Frother	✓	-	-	-	-	-	-

It is not likely that RP1 & RP3 or RP2 & RP4 would be operated at the same time but this possibility exists and is therefore included in the design.

4.4 Sizing Screen

The sizing screen specified in the Phase II report, Section 4 Item 4-2, is not required. It will be replaced by the Derrick Model 524-36MS-1 unit that the C.R.L. has already purchased and is available.

Derrick has confirmed that the C.R.L. unit is capable of the required duty.

4.5 Process Pumps

The seven main process pumps specified in the Phase II report, Section 4, Item 4.9, will remain the same except that the discharge heads will increase from 10 to 16 feet (3 to 5 m). This will not increase the 1½ hp motors originally included.

The discharge head of Pump 5 has been increased to 100 feet (30 m) at the request of C.R.L. This has necessitated a change in pump size to 1 x 1½ x 11 with a 7½ hp motor.

4.6 Screw Conveyor

Two screw conveyors are required for discharging dewatered products off the trailer. One will collect the deslimining screen overflow and the second collect the dewatering screen overflow. The two conveyors will be identifical each rated to handle approximately 1.50 MTPH.

Equipment: - Sullivan Strong Scott 6" diameter screw conveyor 10'-0" long horizontal.

4.7 Existing Wemco Flotation Cells

The existing Wemco 5 x No. 36 froth flotation cells require certain modifications to make them suitable for usage on the mobile plant:

i) The intermediate connection box must be removed to make the unit a continuous single level bank of 5 cells.

ii) The mechanism motors need replacing or rewinding to suit a 480/3/60 power supply.

iii) The froth paddles need modifying to provide only one skimmer system for each side. The motors need to be made suitable for 480/3/60 power supply.

iv) The level control system supplied withthe froth cells is pneumatic. To conform with the other instrumentation on the trailer this unit should be replaced with an electronic system.

A control loop has been incorporated into the instrumentation design to accommodate an electronic level device on the Wemco cells.

4.8 Lifting Requirements

The items of proprietary equipment should be fitted with lifting lugs to facilitate installation and removal by means of a crane and wire rope sling. The proper location and reinforcement of the lifting points, to ensure structural stability when lifted, will be the responsibility of the equipment manufacturer.

Also the three screens will need to be fitted with hold-down clamps to restrict bounce and ensuring no damage to the unit while the trailer is being hauled. These changes must be released prior to start-up.

PROPRIETARY EQUIPMENT LIST

Proprietary Equipment No.	Description	Equipment Details
P.E. 1	Pump No. 1	Goulds 1 x 1½ x 8 JC.
P.E .2	Pump No. 2	Goulds 1 x 1½ x 8 JC.
P.E. 3	Pump No. 3	Goulds 1 x 1½ x 8 JC.
P.E. 4	Pump No. 4	Goulds 1 x 1½ x 8 JC.
P.E. 5	Pump No. 5	Goulds 1 x 1½ x 11 JC.
P.E. 6	Pump No. 6	Goulds 1 x 1½ x 8 JC.
P.E. 7	Pump No. 7	Goulds 1 x 1½ x 8 JC.
P.E. 8	Desliming Screen	Tyler 2' x 4' Type 110 Ty-Rocket.
P.E. 9	Sizing Screen	Existing Derrick Model J24-36 MS-1 Multifeed.
P.E. 10	Conditioner No. 1 Mechanism	Philadelphia PG-13.
P.E. 11	Conditioner No. 2 Mechanism	Philadelphia PG-14.
P.E. 12	Froth Flotation Cells Bank 1a	Existing Wemco 5 Model 36
P.E. 13	Froth Flotation Cells Bank 1b	Denver 5 No. 15 Cell to Cell.
P.E. 14	Froth Flotation Cells Bank 2a	Denver Two Banks of 5 No. 8 DR.
P.E. 15	Froth Flotation Cells Bank 2b	Denver Two Banks of 5 No. 8 Sub 'A'.
P.E. 16	Froth Pump No. 1	Sala SPVC - 232 - 50.
P.E. 17	Froth Pump No. 2	Sala SPVC - 232 - 50.
P.E. 18	Reichert Spiral Concentrator	Mineral Deposits Mark 10 Twin Start.
P.E. 19	Dewatering Screen	Tema WF 50/I.
P.E. 20	Flotation Reagent Pump No. 1	AMF Cuno Model 10671-96R.
P.E. 21	" " " No. 2	" " " " .
P.E. 22	" " " No. 3	" " " " .
P.E. 23	" " " No. 4	" " " " .
P.E. 24	" " " No. 5	" " 10671-92R.
P.E. 25	" " " No. 6	" " " " .
P.E. 26	" " " No. 7	" " " " .
P.E. 27	" " " No. 8	" " " " .
P.E. 28	" " " No. 9	" " " " .
P.E. 29	" " " No. 10	" " " " .
P.E. 30	" " " No. 11	" " " " .
P.E. 31	" " " No. 12	" " " " .
P.E. 32	" " " No. 13	" " " " .
P.E. 33	Screw Conveyor No. 1	Sullivan Strong Scott 6" dia. Screw.
P.E. 34	Screw Conveyor No. 2	Sullivan Strong Scott 6" dia. Screw.

SALA MACHINE WORKS LTD.
3138 MAVIS ROAD, MISSISSAUGA, ONTARIO, CANADA L5C 1T8/(416) 270-2170 TELEX: 06-961182

Misssissauga, December 17, 1984

Fenco Engineering
33 Yonge St.
Toronto, Ontario. M5E 1E7

Attention: Mr. Dave Webster

OUR QUOTATION NO. 84/3542
YOUR INQUIRY: Verbal

Gentlemen:

We are pleased to submit our prices for the following equipment subject to the terms as per the enclosed Conditions of Sale:

ITEM 1 - QTY. 2

Sala SPVC-232-2" Vertical Pump with cantilevered shaft and integral fabricated steel tank as described in leaflet 8048GB and as per drawing D-13581 c/w mild steel adjustable motor plate; V-belt drive; guard excl. AC motor.

Materials of Construction:

Wear Parts:	Neoprene
Tank:	Neoprene Lined
Shaft:	Neoprene Lined

Approx. weight excl. motor: 340 kg./Each

Price .....CDN.$3,719.00/Each
TOTAL .....CDN.$7,438.00

Operating Conditions:

Flow:	20 IGPM max. (91 l/min.)
TDH:	10 to 15 ft. max. (3 to 4.6 m)
Solids:	25 to 30% by weight
Slurry S.G.:	1.2 (estimated)
Froth Factor:	6 (estimated)
Corrected Flow:	91 x 6 = 546 l/min.
Pump Speed:	900 RPM
BHP:	1.0 x 1.2 = 1.2
Motor:	3 HP, 1800 RPM

Electric Motor - Recommended: 3 HP; 1800 RPM; TEFC; 575V; 3 Ph; 60 Hz; 1.15 S.F.; 182T frame.

Weight: 39 kg./Each.

Price .....CDN.$291.00/Each
TOTAL (2 Motors) .....CDN.$582.00

Cont'd...../2

Freight conditions will be 'Collect' if not specified and mutually agreed upon.

DELIVERY:

Equipment: 12-weeks after order or after receipt of approved drawings, if required.
Drawings for Approval: 2-weeks after receipt of Purchase Order.
Certified drawings: 2-weeks after receipt of approved drawings.
Installation & Maintenance manuals: Will be supplied with Certified drawings.

The above quoted prices are F.O.B. our plant, Mississauga, Ontario, and are valid for acceptance 30 days from the date of quotation and firm for delivery before July 31, 1985. Sales taxes, if applicable, are not included in the prices.

TERMS: As per the enclosed Conditions of Sale and the following payment condition: 100% 30-days after shipment or offer to ship.

PAINTING: Mild steel parts will be painted as per enclosed Sala painting program A-11120, Rev.1. Stainless steel parts will not be painted.

TESTS: Standard tests performed are a visual inspection and a dry-run test.

RECOMMENDED SPARE PARTS: As per enclosed sheet.

Yours truly,

Peter Dominici
Product Manager, Pumps

PD/ad.
Encl: Leaflet 8048GB; Dwg. D-13581;
Performance Curve PC-V0200;
Recommended Spare Parts;
Painting Program; Conditions of Sale.

DELIVERED - (Original + 1 copy)

cc. A-CC, Toronto, Ontario.

SALA MACHINE WORKS LTD.

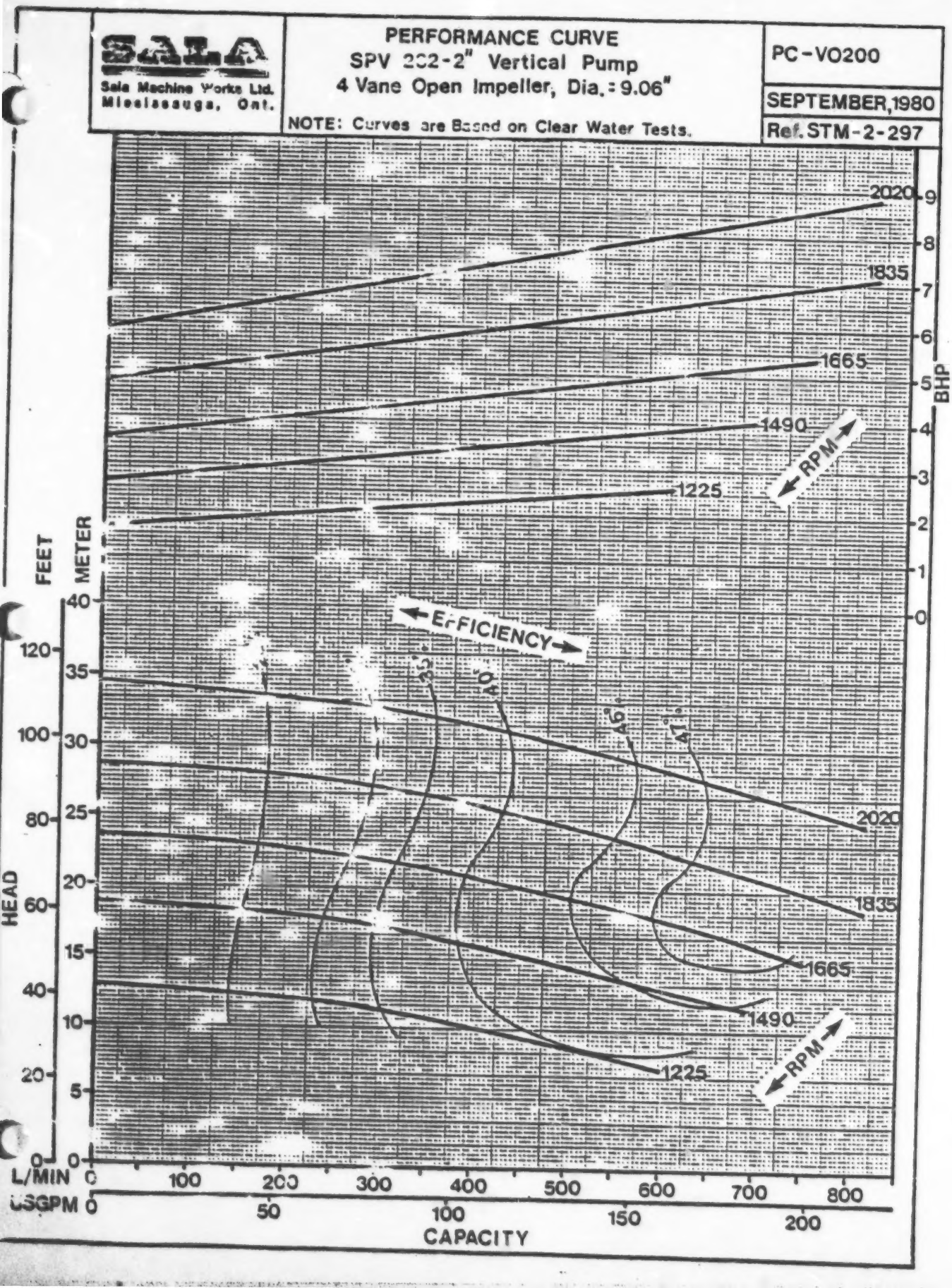
Mississauga, December 17, 1984
Fenco Engineering
OUR QUOTATION NO. 84/3542

RECOMMENDED SPARE PARTS FOR ONE YEAR OPERATION

Model: SPVC-232-2"

Part No.	Qty.	Description	Wt./Lbs.	Price Ea. CDN.$
138413-M1	2	Casing, Neoprene	13.5	$ 606.00
138412-M3	2	Impeller, Neoprene	2.2	$ 242.00
138414-M3	2	Inlet, Neoprene	1.6	$ 209.00
10202-1	1	Impeller Key	--	$ 4.69
5.7 x 229.3	1	O-Ring	--	$ 17.04
5.7 x 168	1	O-Ring	--	$ 14.70
138438-1	1	Rubber Gasket	--	$ 14.70
M8 x 30	2	Impeller Bolt, S.S.	--	$ 4.69
138437-1	1	Impeller Washer	--	$ 14.70

PD/ad.


SALA
Sala Machine Works Ltd.
Mississauga, Ont.
PERFORMANCE CURVE
SPV 202-2" Vertical Pump
4 Vane Open Impeller, Dia.: 9.06"
NOTE: Curves are Based on Clear Water Tests.
PC-VO200
SEPTEMBER, 1980
Ref. STM-2-297
2020
1835
1665
1490
1225
RPM
BHP
EFFICIENCY
25%
40%
60%
70%
FEET
METER
HEAD
L/MIN
USGPM
CAPACITY

SALA MACHINE WORKS LTD.
3136 MAVIS ROAD, MISSISSAUGA, ONTARIO, CANADA L5C 1T8/(416) 270-2170 TELEX: 06-961182

Mississauga. December 17, 1984

Fenco Engineering
33 Yonge St.
Toronto, Ontario.
M5E 1E7

Attention: Mr. Dave Webster

Re: Our Quotation No. 84/3542 for 2 only
SPVC-232-2" Integral Cone Tank Pumps

Dear Mr. Webster:

Attached, please find our above quotation for the required Pumps. Please note that the prices quoted are for our standard pump design and that any design modifications would incur an additional cost. I understand from our previous phone conversations, that you will probably be requiring some modifications to our standard design, in which case we can quote additional prices once you have finalized your requirements.

I trust the quotation will be to your satisfaction. If you have any questions or require further information, please do not hesitate to call.

Yours truly,

Peter Dominici
Product Manager, Pumps

PD/ad.
Encl.

DELIVERED

cc. A-CC, Toronto, Ont.

SALA SLURRY PUMPS
Cone Pump Type SPVC

PURPOSE BUILT FOR FROTHY SUSPENSIONS

SALA'S CONE PUMP IS DESIGNED TO INCREASE THE PUMPABILITY OF FROTHY SUSPENSIONS. THE PRINCIPAL OF OPERATION IS PARTLY SIMILAR TO THAT OF CYCLONE SEPARATION. AIR IS SEPARATED FROM THE SLURRY IN A VORTEX CREATED BY THE IMPELLER ROTATION AND THE TANGENTIAL INLET TO THE PUMP'S CONICAL SUMP. THIS RESULTS IN A MORE EFFICIENT PUMPING AT HIGHER CAPACITIES AND SMOOTHER OPERATION.

SIMPLE INSTALLATION
Because the pump, the sump and the motor are integrated to one unit, there is no levelling or special foundation required.

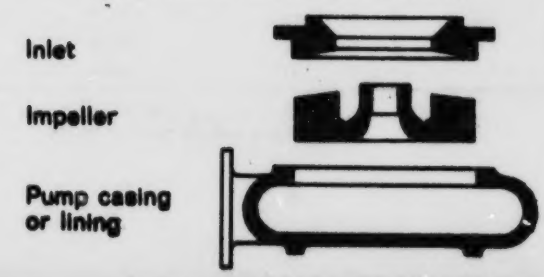
NO STUFFING BOX
The pumps operate without stuffing box or other submerged shaft seals, which further simplifies maintenance and eliminates any requirement for seal water.

BEARINGS
The robust bearing assembly is fitted with grease lubricated roller bearings. All bearings are rated for more than 60,000 running hours and are placed well above the slurry level.

WEAR PARTS
Standard wear parts are available in soft natural rubber or Ni-hard alloy. For special applications wear parts of silicon carbide or synthetic rubber are available. The design of the SALA pumps allows combination of different wear part materials to be used in order to optimize the service life of the wear parts. The SPVC pumps have a built in raise and lowering mechanism for the pump casing to enable the wear parts to be easily accessible. The largest pump, however, requires an external lifting device.

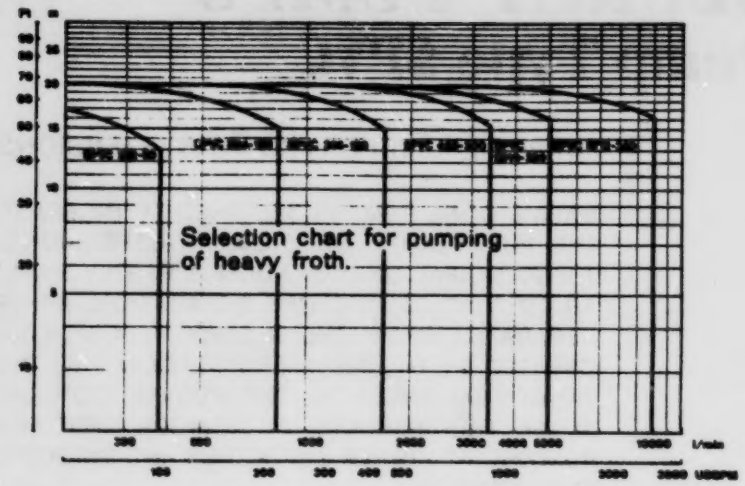
SALA HAS A LONG AND VARYING EXPERIENCE IN THE PUMPING OF FROTHY LIQUIDS. WITH OUR WIDE EQUIPMENT RANGE, WE CAN ASSIST IN SOLVING YOUR PARTICULAR PUMPING PROBLEM.

WEAR PARTS IN THE SPVC-PUMP



SALA

Selection of pump size



Motor size

Motor size and V-rope drive varies with the pump application.

Necessary data for stating pump speed and motor power are:

Flow (l/min, GPM or alike)
Liquid density (kg/m³)
Total discharge head (m, ft)

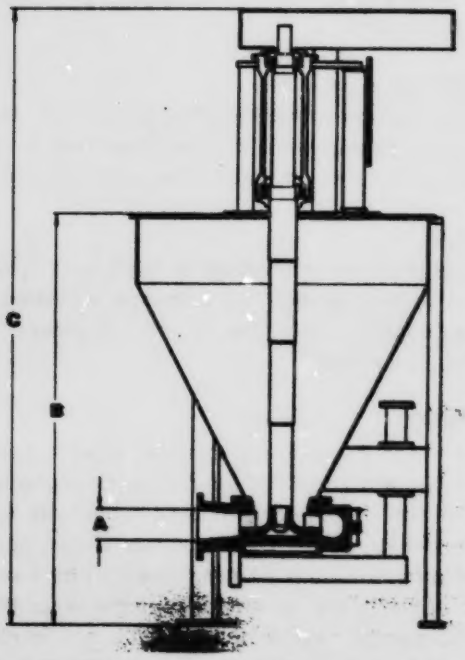
Definition of pump

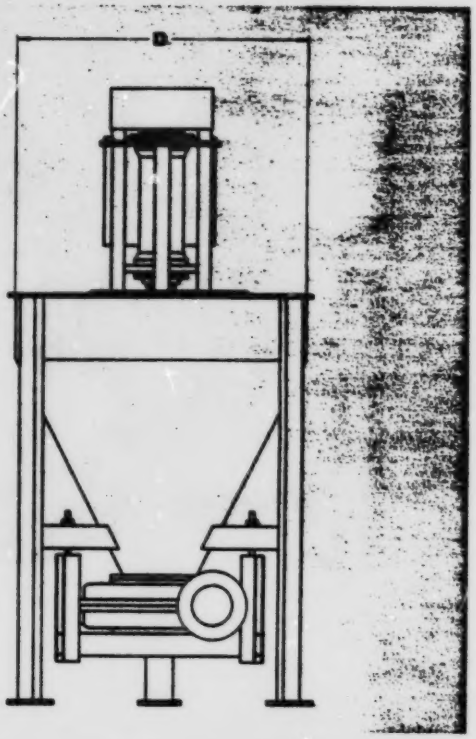
SPVC is the type designation and the figures state the size according to the following:

458 — 200

Impeller dia. in cm	Height of vanes in cm	Discharge connection mm

Dimensions mm





Pump size	Discharge A	B	C	D	Sump volume m³	Max. motor size IEC	kW	Weight excluding motor and drive. Rubber wear parts kg
SPVC 232- 50	50	1000	1600	800	0,14	132 M	7,5	340
SPVC 304-100	100	1730	2700	1400	0,82	225 M	45	900
SPVC 365-150	150	1730	2700	1400	0,82	225 M	45	1000
SPVC 458-200	200	2500	3780	1850	2,3	315 S	110	2500
SPVC 5010-250	250	2500	3760	1850	2,3	315 S	110	2700
SPVC 8712-350	350	2900	4500	2700	5	315 MA	132	6400

Dimensions are preliminar and can be changed without further notice.

SALA
Sala International AB
S-733 00 Sala, Sweden - Tel. 0224-132 20 - Telex 7536

Hayward Gordon Ltd.

Process Pumps and Agitators

7485 Bath Rd., Malton, Ont. L4T 1L3 Telephone 416-677-6400

Branch Offices: Montreal, Winnipeg, Vancouver, Calgary Telex 06-968623

December 19, 1984.

Fenco Engineers Inc.,
33 Yonge Street,
Toronto, Ontario.
M5E 1G4

Attention: Mr. D. Webster

Subject: Mobile Plant - Canmet
Hayward Gordon Quotation 2T4,365

Gentlemen;

Thank you for your interest in our equipment, our quotation is attached for your consideration.

As requested we have submitted prices as per your specifications. We have included a price for a second upper propeller should there be a problem with wetting out and drawing down the coal fines.

If you have any questions concerning the equipment or this quotation, please feel free to contact us.

Yours truly,

HAYWARD GORDON LIMITED

Peter McGovern, P. Eng.,
Senior Application Engineer,
Philadelphia Mixers.

PM/bh

c.c. Terrance Frank,
Applications Engineering.

UOTATION FOR

PHILADELPHIA MIXERS

HAYWARD GORDON LTD.

TORONTO — 7485 Bath Road, Malton, Ont. L4T 1L3
Tel. (416) 677-6400 — Telex 06-968623
MONTREAL — 315 Dorval Ave., Dorval, Que. H9S 3H6
Tel. (514) 631-4301 — Telex 05-821813
CALGARY — 4420 MacLeod Trail S.W., Suite 230, Calgary, Alberta T2G 4Y7
Tel. (403) 263-5858 — Telex 03-826610
VANCOUVER — 11575 Bridgeport Rd., Richmond, B.C. V6X 1T5
Tel. (604) 273-7242 — Telex 04-355770
DISTRIBUTORS — [illegible] Sudbury, Winnipeg

	QUOTATION NO.		CUSTOMER REF.
ecember 19, 1984	2T4,365	PAGE 1 OF 2	Mobile Plant - Canmet

Fenco Engineers Inc.,
33 Yonge Street,
Toronto, Ontario.
M5E 1G4

Attention: Mr. D. Webster

SUBJECT

TERMS & CONDITIONS: NET CASH 30 DAYS (SEE OVER)
F.O.B.: OUR PLANT MALTON, ONTARIO
SALES TAXES: NOT INCLUDED
SHIPMENT: 2 WEEKS FROM RELEASE TO MANUFACTURER

	QUANTITY	MODEL	UNIT PRICE	LOT PRICE
A	1	PG-13	$999.00	$999.00

IXER PROCESS CAPABILITY

Make up and maintain suspension of fine coal and water.

ESIGN CONDITIONS ATERIALS TO BE MIXED	SPECIFIC GRAVITY	VISCOSITY (CPS.)	PERCENTAGE BY WT/VOL.	PARTICLE SIZE (MESH)	SETTLING RATE (FT./MIN.)
Water, 15% Fine Coal and Chemicals For Floatation	1.1 assumed	waterlike assumed			

AL VOLUME : 142 US gallons
TANK SIZE : 34" dia. X 44" high
BAFFLES : not required
PRESSURE : atmospheric

TEMPERATURE : ambient
MIXING LEVEL : --
MIXING CLASS : --
MIXING CYCLE : continuous

IXER CONSTRUCTION

RIVE : helical reducer output 350 RPM
HAFT SIZE : 3/4" dia. X 36" long
PELLERS : single 9½" propeller
ATERIALS : 316 stainless steel
HAFT SEAL : not required

MOUNTING : clamp mount
MOTOR : 1/3 HP, 1/60/110 volt TEFC
FEATURES :
Extra for unit to be equipped with a second propeller.....$124.00.

TERATURE	OFFICE	
lletin: HPCM	Toronto	Peter McGovern, P. Eng., Senior Application Engineer.

ARKS

PM/bh

CUSTOMER

QUOTATION FOR

PHILADELPHIA MIXERS

HAYWARD GORDON LTD.

TORONTO — 7485 Bath Road, Malton, Ont. L4T 1L3
Tel. (416) 677-6400 — Telex 06-966623
MONTREAL — 315 Dorval Ave., Dorval, Que. H9S 3H6
Tel. (514) 631-4301 — Telex 05-821813
CALGARY — 4400 MacLeod Trail S.W., Suite 230, Calgary, Alberta T2G 4Y7
Tel. (403) 263-5858 — Telex 03-826610
VANCOUVER — 11575 Bridgeport Rd., Richmond, B.C. V6X 1T5
Tel. (604) 273-7242 — Telex 04-355770
DISTRIBUTORS — London, Sudbury, Winnipeg

DATE	QUOTATION NO.		CUSTOMER REF.
December 19, 1984	2T4,365	PAGE 2 OF 2	Mobile Plant - Canmet

TO
Fenco Engineers Inc.,
33 Yonge Street,
Toronto, Ontario
M5E 1G4

Attention: Mr. D. Webster

SUBJECT

TERMS & CONDITIONS: NET CASH 30 DAYS (SEE OVER)
F.O.B.: OUR PLANT MALTON, ONTARIO
SALES TAXES: NOT INCLUDED
SHIPMENT: WEEKS FROM RELEASE TO MANUFACTURER

ITEM	QUANTITY	MODEL	UNIT PRICE	LOT PRICE
B	1	PG-14	$991.00	$991.00

A- MIXER PROCESS CAPABILITY

Make up and maintain suspension of fine coal and water.

B- DESIGN CONDITIONS

MATERIALS TO BE MIXED	SPECIFIC GRAVITY	VISCOSITY (CPS.)	PERCENTAGE BY WT/VOL.	PARTICLE SIZE (MESH)	SETTLING RATE (FT./MIN.)
Water, 15% Fine Coal Chemicals	1.1 assumed	waterlike assumed			

FINAL VOLUME : 90 US gallons
TANK SIZE : 27" dia. X 44"
BAFFLES : not required
PRESSURE : atmospheric

TEMPERATURE : ambient
MIXING LEVEL : --
MIXING CLASS : --
MIXING CYCLE : continuous

C- MIXER CONSTRUCTION

DRIVE : helical in-line output 350 RPM
SHAFT SIZE : 3/4" dia. X 36" long
IMPELLERS : single 9" propeller
MATERIALS : 316 stainless steel
SHAFT SEAL : not required

MOUNTING : clamp mount
MOTOR : ½ HP, 1/60/110 volt TEFC
FEATURES :
Extra for unit to be equipped with a second propeller.....$83.00.

LITERATURE
Bulletin: HPCM

OFFICE
Toronto

Peter McGovern, P. Eng.,
Senior Application Engineer.

REMARKS

PM/bh

CUSTOMER

HAYWARD GORDON LTD.

TERMS AND CONDITIONS OF SALE

1. This proposal is a quotation only and is not binding on Hayward Gordon Limited (hereinafter called the "Company") unless accepted within 30 days from date hereof, and thereafter approved by the Company.

2. This quotation and any contract resulting therefrom, including the terms of payment specified, is subject to the purchaser demonstrating and maintaining a credit position satisfactory to the Company up to the date of shipment.

3. If the quotation includes equipment not of the Company's manufacture, the price of such equipment shall be subject to adjustment by the same percentage change as may be made effective by the suppliers prior to the date of shipment. All payments to be in Canadian funds at par Toronto. Prices quoted herein are subject to change without notice.

4. The Company warrants all quoted equipment will perform the process function for which it is recommended, provided pertinent and accurate items or data were submitted by the user. If the unit does not perform the process function as the Company recommended, it may be returned, freight prepaid, for full refund or at the Company's option, the Company will supply equipment which will perform the process function at no additional charge.

5. The Company endeavours to supply equipment of the highest quality both in materials and workmanship, however, if within one year from date of shipment, any part of the equipment manufactured by the Company is proved to have been defective, at the time of shipment, in material or workmanship, the Company shall have the right and obligation to promptly repair such part or, if in its opinion necessary, to furnish F.O.B. its works a similar part, provided that written notice is given to the Company immediately upon discovery of such defect. This guarantee may be extended by written agreement between the Company and the purchaser to suit Customer's specific requirements for specific equipment or portions thereof. Such agreements must be clearly stated in the quotation or other written agreement if to be considered valid. The materials are certified to be of the specified analysis, however the materials are not guaranteed against chemical or abrasive attack. The Company reserves the right to require the return of defective parts, freight prepaid, before any claim is recognized. No other warranty or condition, whether statutory or otherwise is made, intended or to be implied and exception for its obligation to repair or replace defective parts or otherwise is made, intended or to be implied and exception for its obligation to repair or replace defective parts as provided for above, the Company shall not be liable in any event for loss of profits or revenue, interest, loss by reason of shutdown or non-operation, increased expense of operation of the equipment, loss of use of power systems, cost of purchase or replacement power or claims of purchaser or Customers of purchaser for service interruptions, or any special indirect, incidental or consequential damages arising out of this contract or any breach thereof or any defect in, or failure of, or malfunction of the apparatus furnished hereunder.

   In any event, the liability of the Company with respect to the supply of defective equipment or machinery shall not exceed the purchase price of such equipment or machinery on which such liability is based. For equipment included in this proposal, but manufactured by others, the Company will endeavour to assign to the purchaser the guarantee extended by such manufacturers to the Company.

   The Company will accept no liability whatsoever for this equipment if resold by purchaser to a third or subsequent parties unless (1) each new service is reviewed by the Company; (2) the equipment is fully inspected in the Company's plant; and (3) a written liability release is supplied by the Company to the third or subsequent parties.

6. Shipping promises specified will date from receipt by the Company, of approval drawings and all information required for manufacture and are contingent upon fires, floods, strikes, lockouts, riots or accidents in our works or the works of those furnishing material or services to the Company, delays in transportation, or any other cause beyond the reasonable control of the Company. Drawings for approval will be supplied two (2) to four (4) weeks from receipt of order unless the equipment supplied is to be especially designed, in which case, a mutual agreement will be made on delivery time of approval drawings.

7. The Company shall retain title to all equipment furnished under this quotation until full payment has been received. Should the purchaser default in making any payment when due, the Company will be free to enter the premises where such equipment may be located and remove the same as its property whatever may be the mode of its attachment to realty or other property without prejudice to any further claims on account of damages sustained the Company may suffer by reason of the purchaser's default or failure to surrender the equipment when required to do so. The Company may sell any equipment repossessed as aforesaid and the purchaser shall remain liable to the Company for any deficiency.

8. Any additional costs incurred by the Company in special packaging or painting or any special tests or inspection which is requested by the purchaser either orally or in written form, which are additions to the Company's normal procedures and not covered in the Company quotation or purchaser's order, will be charged to the purchaser.

9. Claims for shortages must be made within ten (10) working days after receipt of the material.

10. The purchaser shall not return any material to the Company for any reason without prior authorization from the Company and without first prepaying all transportation costs.

11. All orders having been accepted by the Company and the purchaser shall not be subject to cancellation unless so stipulated by prior written agreement, and revisions and changes to the orders after acceptance shall be made upon the written agreement of the Company, which may be granted, withheld or conditioned upon payment of a cancellation charge at the Company's sole discretion.

12. Any waiver by the Company of any breach of these provisions shall not be construed as a waiver or any other breach.

Sullivan Strong Scott

September 21, 1984

Fenco Engineering Inc.
33 Yonge St.,
Toronto, Ont.
M5E 1E7

Attention: Mr. David S. Webster

Gentlemen:

We are pleased to submit the enclosed quotation for the supply of two 6"diameter screw conveyors.

These units are complete with a roller assembly and guide track for pushing/pulling the units into place.

The drives are mounted at the inlet ends. We will supply a hook arrangement on the screws to accept cables, (supplied by others) that will hold the conveyors up.

Please note we have included the supply of explosion proof motors.

Thank you for the opportunity of quoting on your requirements and please do not hesitate to contact us, if we may be of any further assistance.

Yours truly,

SULLIVAN STRONG SCOTT LTD.

C. Fulton
Sales Representative

CF-tk

Encl.

Sullivan Strong Scott
Vancouver Calgary Saskatoon Winnipeg Toronto Montreal Halifax
Bulk Materials Handling and Processing Systems

Date: September 21, 1984
To: Fenco Eng.Inc.
33 Yonge St., Tor.Ont. M5E 1E7

QUOTATION

Attention of: David S. Webster

Reference
#22588

Subject:
Two 6"Dia.Screw Conveyors

Gentlemen:
We are pleased to submit herewith our quotation covering our understanding of your requirements.

Sullivan Strong Scott Ltd.
Per: C. Fulton
C. Fulton -
Sales Rep.

Two 6"dia.Special Screw Conv.Assy's 10'0"lg horizonal, to handle 1.41TPH of Fine Coal weighing 50lbs./cu.ft., each comprising of:

1 9'10"lgth 6H304 6"dia.RH Hel.Conv.Screw, flights int.welded to a 2" dia.SCH.40 pipe, full pitch for full length with 7"bare pipe on disch. end

1 8'1-1/2"lgth CTC616F flanged cover

1 10'0"lgth CTF612 6"formed flange trough, 12ga.mild steel c/w 3 only roller mtg brackets, each with 2 Torrington(or equal) roller assy's

1 Guide track fabricated of mild steel to suit roller assy's to allow 6'0"of travel

2 6"End flange gaskets, std black neoprene

1 Set cover gaskets, fitted, std black neoprene

4 CCAF6 6"Clampseals

1 Support hook (cable by others)

Cont'd.....

1 24"x7"Inlet Spout approx.3"high flanged (not drilled) fitted to trough

1 CSD612 6"Stub Disch.Spout flanged (not drilled) welded to trough 6"CL to end

1 CE6112 6"Trough endplate (without feet) for 1-1/2"dia.shaft.

Note: One to suit Dorris reducer.

1 CEB112BB 1-1/2"flange ball bearing

1 CSW112 1-1/2"Wastepack seal, fitted

1 CES3-112 1-1/2"Tailshaft

2 1/2"x3"long Bolts with nuts

1 TE6 Dorris Trough End

1 107W Dorris Motorbase

1 Model 107SCD20-1-1/2"Dorris Screwdriver reducer unit, located at inlet end, in pos.Top, Rated for class II Service at 45output RPM

One 1-1/2HP V-belt drive, 1740-900 RPM c/o:

1 3.4"PD 2Gr B Section Sheave

1 SH bushing 7/8"bore

1 6.6"PD 2Gr B Section Sheave

1 SDS bushing 7/8"bore

2 B-42 Matched V-belts (13.7"C-C)

1 V-Belt Drive Guard, open type, mild steel

One 1-1/2HP Exp.Proof Class II Gr.G Motor 3/60/550 1800RPM Fr.145T
Above conv.assembled, fitted, match marked & test run

Price: $ 5,370.00 Lot Net

FOB: Downsview, Ont. Sales Taxes Extra, if applicable
Delivery: 6-8 Weeks from receipt of approval drawings
Terms: Net 30 Days from date of invoice.

Prices quoted are firm for 30 days. Due to escalating costs of raw materials and purchase items, we reserve the right to review this quotation after October 21, 1984.

SECTION 5

MECHANICAL DETAILS AND DRAWINGS

5.0 MECHANICAL DETAILS AND DRAWINGS

5.1 General

The following equipment layout and detailed platework drawings are included in this section of the report.

Drawings

42022-GA-01	Rev. 0	General Arrangement Plan of Floor Level & Section 'A-A'. All Process Options
42022-GA-02	Rev. 0	General Arrangmement Plan on Top Level & Section 'B-B'. Process Options 1, 2 & 3
42022-GA-03	Rev. 0	General Arrangement Plan on Top Level & Section 'B-B'. Process Options 4 to 7
42022-GA-04	Rev. 0	General Arrangement of Trailer Plan & Elevations
42022-D-01	Rev. 0	Sump 1, 2, 3, 4, & 5 and Wemco Size 36 Froth Launder - Details
42022-D-02	Rev. 0	Desliming Screen Underpan, Sizing Screen Discharge Chute, Conditioner 1 &B 2 and Water Tank - Details
42022-D-03	Rev. 0	Dewatering Screen Underpan, Denver Cell No. 15, No. 8 D-R and No. 8 Sub-A Launder Details
42022-D-04	Rev. 0	Collector, Promotor & Frother Tank; Pump Base Details

These drawings are self-explanatory and show all pertinent constructional details.

The platework fabricator will be required to produce his own shop fabrication drawings.

The construction contractor will have final responsiblity for checking and finalizing these drawings to suit the certified drawings of the proprietary items of equipment.

Note should be taken that modifications will be necessary to some of the equipment already purchased by C.R.L. and also to those items which will need to be purchased to suit installation in the mobile plant. These modifictaions have been adequately detailed in the report text and on the drawings.

5.2 Painting

The painting specification shall be the responsibility of the Owner. However, we have provided general painting recommendations for platework, piping and structural steelwork on the trailer as a guide.

Proprietary equipment will be to manufacturer's standard finish unless instructed otherwise by the Owner.

Consideration should be given to the overall colour scheme of the mobile plant to make it aesthetically pleasing. It is suggested that only a few colours be used.

SECTION 6

PIPING & VALVE DETAILS AND DRAWINGS

6.0 PIPING & VALVE DETAILS AND DRAWINGS

6.1 General

Piping shall be Schedule 80 PVC. Pipe runs for all pumps shall be permanently installed to downstream point of instrumentation. These permanent sections shall include volumetric flow meter, conductivity meter and mass flow meter. In process options where pump discharge is re-routed, the pipe run direction change shall be made after the instrumentation.

Included is a pipe run list showing the pipe diameter and process option utilization. Also included is a valve list.

All pertinent details regarding pipe runs and valve locations on the mobile plant are shown on the drawings included herein.

Pipe runs are shown on the general arrangement drawings included in this section. These drawings show proposed runs but are not detailed installation drawings; the precise and actual routings will be done by the construction company.

42022-M-01	Piping Arrangement Plan on Floor Level & Section 'A-A' Process Option 1
42022-M-02	Piping Arrangement Plan on Top Level & Section 'B-B' Process Option 1
42022-M-03	Piping Arrangement Plan on Floor Level & Section 'A-A'
42022-M-04	Piping Arranement Plan on Top Level & Section 'B-B'

Pipe Run List

Pipe Line No.	Section No.	Start Point	Discharge Point	Pipe Diam.	Process Options 1	2	3	4	5	6	7
01	01	Pump No. 1	Desliming Screen	2"	✓	✓	✓	✓	✓	✓	✓
02	02	Pump No. 2	ME No. 2	2"	✓	✓	X	✓	✓	✓	✓
	02A	ME No. 2	Sizing Screen	2"	✓	✓	X	✓	✓	X	✓
	02B	ME No. 2	Reichert Spiral	2"	X	X	X	X	X	✓	X
03	03	Pump No. 3	ME No. 3	1½"	X	X	X	✓	✓	✓	✓
	03A	ME No. 3	Dewatering Screen	1½"	X	X	X	✓	✓	X	✓
	03B	ME No. 3	Sizing Screen	1½"	X	X	X	X	X	✓	X
04	04	Pump No. 4	ME No. 4	1"	X	X	X	✓	✓	✓	✓
	04A	ME No. 4	Sump No. 5	1"	X	X	X	✓	X	✓	✓
	04B	04A	Dewatering Screen	1"	X	X	X	X	✓	X	X
05	05	Pump No. 5	CW Head Tank	2"	✓	✓	✓	✓	✓	✓	✓
	05A	Valve No. LV-13	Termination Point	2"	✓	✓	✓	✓	✓	✓	✓
06	06	Pump No. 6	Froth Flotation Cells Bank No. 1	2"	✓	✓	✓	✓	✓	✓	✓
07	07	Pump No. 7	ME No. 7	1½"	✓	✓	X	✓	✓	✓	✓
	07A	ME No. 7	FF Cells Bank No.2	1½"	✓	✓	X	X	X	X	X
	07B	ME No. 7	Reichert Spiral	1½"	X	X	X	✓	✓	X	✓
	07C	07B	Dewatering Screen	1½"	X	X	X	X	X	✓	X
08	08A	Deslime Screen	Conditioner No. 1	3"	X	✓	✓	X	X	X	X
	08B	Deslime Screen	Sump No. 2	3"	✓	X	X	✓	X	✓	✓
	08C	Deslime Screen	Sump No. 5	3"	X	X	X	X	✓	X	X
09	09	Sizing Screen	Conditioner No. 1	3"	✓	X	X	✓	✓	✓	X
	09A	Sizing Screen	Sump No. 5	3"	X	✓	X	X	X	X	✓

*Pipes shown thus connect between this rig and dewatering rig, and are excluded from our design.

Pipe Run List

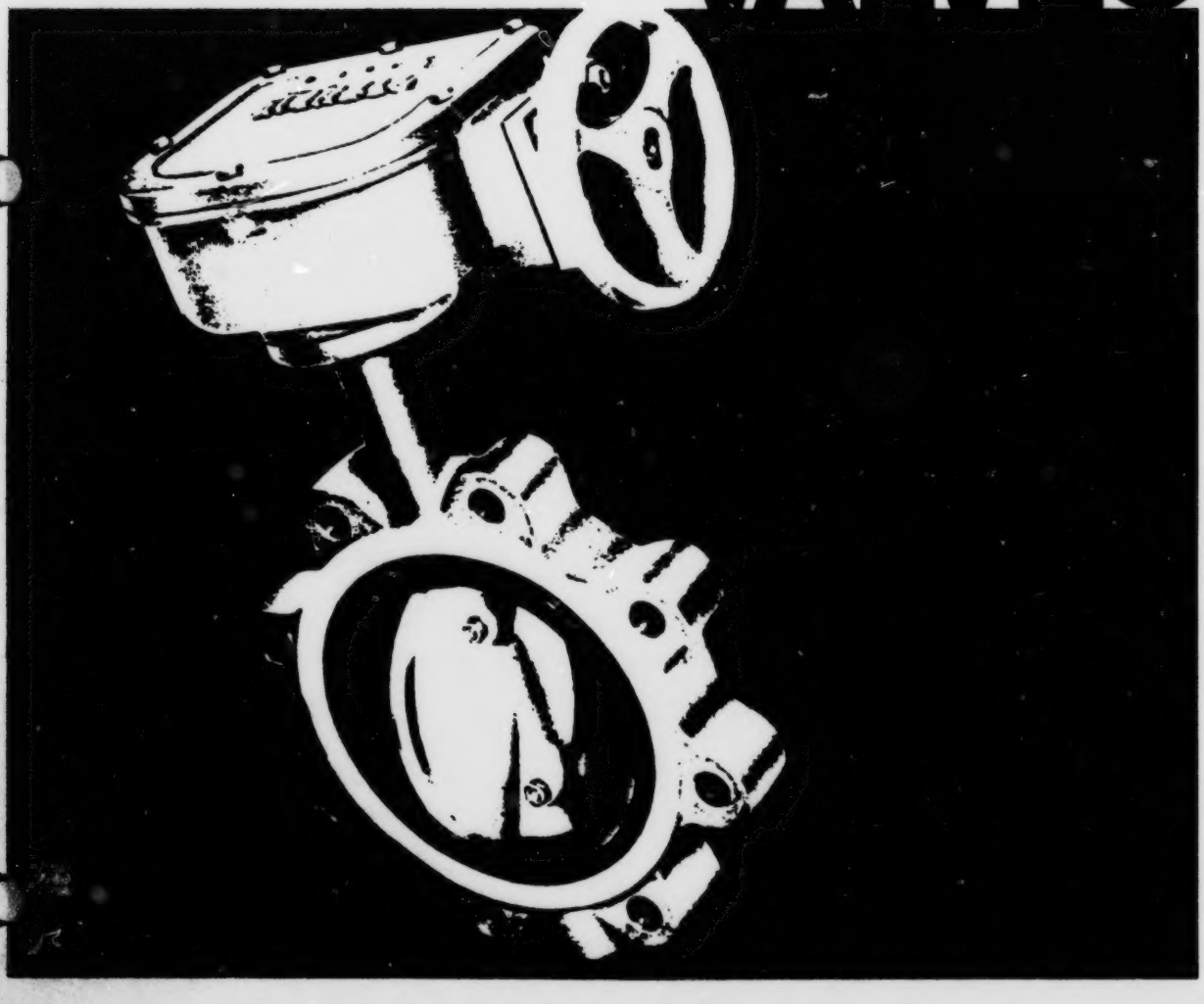
Pipe Line No.	Section No.	Start Point	Discharge Point	Pipe Diam.	Process Options 1	2	3	4	5	6	7
10	10 Route a	FF Cells Bank No. 1	Sump No. 5	3"	✓	X	✓	✓	✓	✓	X
	10 Route b	FF Cells Bank No. 1	Sump No. 2	3"	X	✓	X	X	X	X	X
11	11	FF Cells Bank No. 1	11A	3"	✓	✓	✓	✓	✓	✓	X
	11A	-	Froth Pump No. 1	3" Hose	✓	✓	✓	✓	✓	✓	X
12*	12	Froth Pump No. 1	Dewatering Unit	2" Hose	✓	✓	✓	✓	✓	✓	X
13	13	FF Cells Bank No. 2	Sump No. 5	2"	✓	✓	X	X	X	X	X
14	14	FF Cells Bank No. 2	14	3"	✓	✓	X	X	X	X	X
14	14A	-	Froth Pump No. 2	3" Hose	✓	✓	X	X	X	X	X
15*	15	Froth Pump No. 2	Dewatering Unit	2" Hose	✓	✓	X	X	X	X	X
16	16	FE No. 9	Sump No. 5	1"	✓	✓	✓	✓	✓	✓	✓
	16A*	Dewatering Unit	FE No. 9	1"	✓	✓	✓	✓	✓	✓	X
17	17	C.W. Head Tank	Sumps 2,3,4,5	2"	✓	✓	✓	✓	✓	✓	✓
	17A	"	Sump 1	2"	✓	✓	✓	✓	✓	✓	✓
18	18	C.W. Head Tank	Sump No. 5	3"/2"	✓	✓	✓	✓	✓	✓	✓
19	19	Termination Point	C.W. Head Tank	2"	✓	✓	✓	✓	✓	✓	✓
20	20	Dewatering Screen	Sump No. 5	2"	X	X	X	✓	✓	✓	✓
21	21 Route a	Raw Feed	Sump No. 1	2"	✓	✓	✓	✓	X	✓	✓
	21 Route b	Raw Feed	Sump No. 2	2"	X	X	X	X	✓	X	X
22	-	Froth Reagent Addition		5/16 Tubing as required							

Valve List

Valve No.	Location	Size	Manufacturer	Type	Model
LV01	Sump 1	2"	Dezurik	Electric Actuator Butterfly	0200/FIG 632/L/B/RS50/3/KWGM1/A/C/84135
LV02	Sump 2	2"	"	"	"
LV03	Sump 3	2"	"	"	"
LV04	Sump 4	2"	"	"	"
LV05	Water Tank	2"	"	"	"
LV06	Conditioner 1	2"	"	"	"
LV07	Conditioner 2	2"	"	"	"
LV08	Conditioner 1	3"	Dezurik	Manual Handwheel Butterfly	0300/FIG 632/L/B/RS50/KEG3H8
LV09	Conditioner 1	3"	"	"	"
LV10	Conditioner 2	2"	Dezurik	Manual Handwheel Butterfly	0200/FIG 632/L/B/RS50/KEG3H8
LV11	Conditioner 2	2"	"	"	"
LV12	Pipe No. 5	2"	"	"	"
LV13	Pipe No. 5	2"	"	"	"
LV14	Sump 5	2"	"	"	"
LV15	Water Tank	2"	"	"	"
LV16	Raw Feed Pipe	2"	"	"	"
LV17	Froth Cells Bank 2	2"	"	"	"
LV18	Froth Cells Bank 2	2"	"	"	"
LV19	Reagent Pump 1	¼"	Crane	Manual Gate Valve	Bronze FIG 440 Screwed Ends
LV20	Reagent Pump 2	¼"	"	"	"
LV21	Reagent Pump 3	¼"	"	"	"
LV22	Reagent Pump 4	¼"	"	"	"
LV23	Reagent Pump 5	¼"	"	"	"
LV24	Reagent Pump 6	¼"	"	"	"
LV25	Reagent Pump 7	¼"	"	"	"
LV26	Reagent Pump 8	¼"	"	"	"
LV27	Reagent Pump 9	¼"	"	"	"
LV28	Reagent Pump 10	¼"	"	"	"
LV29	Reagent Pump 11	¼"	"	"	"
LV30	Reagent Pump 12	¼"	"	"	"
LV31	Reagent Pump 13	¼"	"	"	"

BULLETIN 40.00-1
July, 1979

DeZURIK® RESILIENT SEATED BUTTERFLY VALVES



materials and ordering

To order, give the complete valve and actuator identification by specifying the ordering code for each item as shown below. An ordering example is shown at the bottom of the page.

VALVE SIZE

Give size code as follows:

- 0200 = 2"
- 0250 = 2½"
- 0300 = 3"
- 0400 = 4"
- 0500 = 5"
- 0600 = 6"
- 0800 = 8"
- 1000 = 10"
- 1200 = 12"
- 1400 = 14"
- 1600 = 16"
- 1800 = 18"
- 2000 = 20"
- 2400 = 24"
- 3000 = 30"
- 3600 = 36"

FIGURE NUMBER (Body Material)

Give "FIG" followed by the number below to indicate body material:

- FIG 632 = CAST IRON Sizes 2"-36" Wafer or lug bodies

END STYLE

Give end style code as follows:

W = WAFER (Flangeless) Available in cast iron in sizes 2"-36"

- L = LUG (Wafer face-to-face) Available in cast iron only in sizes 2"-36"

24"-36" lug valves have 2 drilled and tapped flanges

SHAFT SEAL

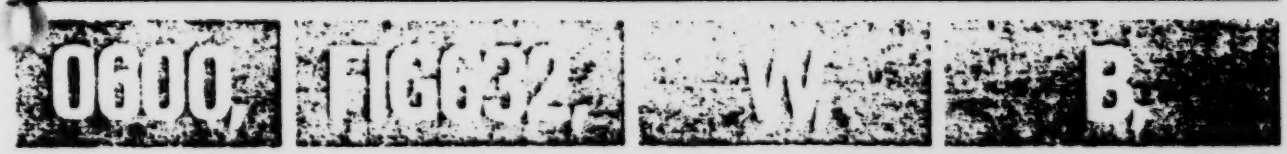
Give shaft seal code as shown below:

2"-20" VALVES

- B = NITRILE-BUTADIENE (Hycar) For use with all seats except RS55, RS47 and RS66
- C = CHLORO-SULFONYL-POLYETHYLENE (Hypalon) For use with RS47 seats only
- D = TERPOLYMER OF ETHYLENE PROPYLENE (Nordel) For use with RS66 seats only

24"-36" VALVES

- F = NITRILE-BUTADIENE (Buna [Vee]) For use with all seats except RS58
- E = TFE (Vee) Must be used with RS58 seat. Available with all other seats.



RESILIENT SEAT

Give "RS" and number:

2"-20" VALVES

RS18 = NITRILE-BUTADIENE (Hycar) An odorless and tasteless compound for food service at temperatures to 180°F.

RS47 = CHLORO-SULFONYL-POLYETHYLENE (Hypalon) For oxidizing chemical service to 200°F.

RS49 = CARBOXYLIC-NITRILE-BUTADIENE (Hycar) A general service compound for non-alkaline applications to 180°F.

RS63 = NITRILE-BUTADIENE (Hycar) For petroleum applications to 180°F.

RS50 = CHLOROPRENE (Neoprene) General service compound for alkaline applications to 180°F.

RS66 = TERPOLYMER OF ETHYLENE PROPYLENE (Nordel) For high temperature water to 250°F.

RS78 = POLYURETHANE (Urethane)

24"-36" VALVES

RS16 = CHLOROPRENE (Neoprene) General service compound for alkaline applications to 180°F.

RS26 = NITRILE-BUTADIENE (Hycar) For petroleum applications to 180°F.

RS47 = CHLORO-SULFONYL-POLYETHYLENE (Hypalon) For oxidizing chemical service to 200°F.

RS54 = FLUORINATED HYDROCARBON (Fluoroelastomer) For high temperature chemicals to 300°F.

RS66 = TERPOLYMER OF ETHYLENE PROPYLENE (Nordel) For high temperature water to 250°F.

Recommendations above describe general service conditions only. For specific recommendations, see DeZURIK Rubber Recommendations List or contact the factory.

DISC, SHAFT AND BEARING MATERIAL

Give number 1 through 21 as shown below:

CODE	MATERIAL	SIZES
1	Bronze disc, 416 stainless steel shaft, bronze bearings in 2"-20", reinforced TFE bearings in 24"-36"	2"-36"
2	Cast iron disc with welded nickel edge, 416 stainless steel shaft, bronze bearings in 4"-20", reinforced TFE bearings in 24"-36"	4"-36"
3	316 stainless steel disc and shaft, TFE-coated stainless steel bearings	2"-20"
5	Bronze disc, 316 stainless steel shaft, TFE-coated stainless steel bearings in 2"-20", reinforced TFE bearings in 24"-36"	2"-36"
6	Cast iron disc with welded nickel edge, 316 stainless steel shaft, TFE-coated stainless steel bearings in 4"-20", reinforced TFE bearings in 24"-36"	4"-36"
8	Bronze disc, 304 stainless steel shaft, reinforced TFE bearings	24"-36"
9	Cast iron disc with welded nickel edge, 304 stainless steel shaft, reinforced TFE bearings	24"-36"
12*	Cast iron disc with welded nickel edge, 416 stainless steel shaft, bronze bearings in 4"-20"	4"-20"
13*	Bronze disc, 416 stainless steel shaft, bronze bearings in 2"-20"	2"-20"
14	Electroless nickel coated cast iron disc, 416 stainless steel shaft, bronze bearings in 2"-20", reinforced TFE bearings in 24"-36"	2"-36"
15	Electroless nickel coated cast iron disc, 316 stainless steel shaft, TFE-coated stainless steel bearings	2"-36"
16	Electroless nickel coated cast iron disc, 304 stainless steel shaft, reinforced TFE bearings	24"-36"
17*	Electroless nickel coated cast iron disc with 416 stainless steel shaft, bronze bearings in 2"-20"	2"-20"
18**	Cast iron disc with welded nickel edge, 416 stainless steel shaft, bronze bearings	2"-16"
19**	Bronze disc, 416 stainless steel shaft, bronze bearings	2"-16"
20**	Electroless nickel coated cast iron disc, 416 stainless steel shaft, bronze bearings	2"-16"
21**	316 stainless steel disc and shaft, TFE-coated stainless steel bearings	2"-16"

*For 25 psig uni-directional shutoff. Contact factory for shutoff requirements up to 100 psig.
**For diaphragm actuators, 25 psig uni-directional shutoff.

ACTUATOR AND ACCESSORIES

All actuators must be ordered by adding the actuator number to the basic valve identification. Actuator descriptions and ordering information are shown in actuator sections.

Lever Actuators —Page 12

Rotary Manual Actuators —Pages 12 and 13

On-Off and Positioning Cylinder Actuators —Pages 14 and 15

Electric Motor Actuators —Pages 16 and 17

Diaphragm Actuators —Pages 18 and 19

Order accessories as shown in accessory sections.

Manual Accessories —Pages 20 and 21

Cylinder Accessories —Pages 22 and 23

RS49, 2, KWG3C4.

2"-20" manual actuators

LEVER ACTUATORS

10-Position Levers (Photo 1)

Positive latching A 10-position dial provides positive latching in open, closed and eight intermediate positions. Pointer indicates disc position. (Optional adjustable memory stop.)

Lock to prevent tampering A notch in the handle allows use of a standard padlock to prevent unauthorized valve operation.

Infinite-Position Levers* (Photo 2)

Adjustable throttling position Hand tightening of the threaded shaft against the dial plate holds the disc in any desired position. Graduated dial indicates disc position.

Adjustable Memory Stop All infinite-position levers have an adjustable memory stop to allow the valve to be closed and reopened to the same position. (Photo 3)

Ordering Levers
To order, add lever number to basic valve identification. Actuators can be mounted at 90° increments from standard. Black area indicates disc position. Lever size range is shown below. Handwheel actuators are recommended for valves above 6" and where water hammer may occur due to sudden valve closure.

*Patented U.S. 3,537,473

Number		Lever Style
KLG1	=	10-Position Lever (2"-12" valves only)
KLG2	=	Infinite-Position Lever (2"-10" valves only)

FIG 603, Memory Stop (Used with KLG1 only) An adjustable stop used to return valve to a preset open position after shutoff. A common application for this feature is air conditioning or heat exchanger balancing. Order FIG 603, 0200, R.

ROTARY MANUAL ACTUATORS

Enclosed construction Includes: stamped steel cover with position indicator window. (Photo 4)

Weatherproof construction Includes: cast iron cover with position indicator window and gasket; seals on the actuator input shaft and thrust plate. (Photo 5)

Buried construction Includes: cast iron cover with gasket; seals on the actuator input shaft and thrust plate; stainless steel bolts on actuator cover and on end cap; sealed connection between the valve neck flange and actuator base. (Photo 6)

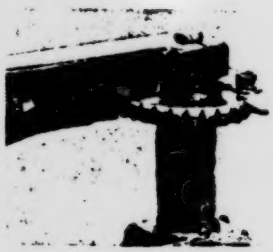
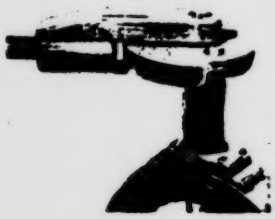
Actuator Input
Actuators are available with a variety of manual inputs as follows:
Crank (Photo 4)
Handwheel (Photo 5)
2" Square Nut (Photo 6)
Chainwheel

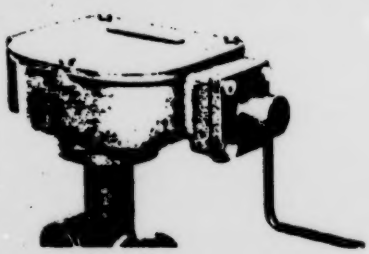
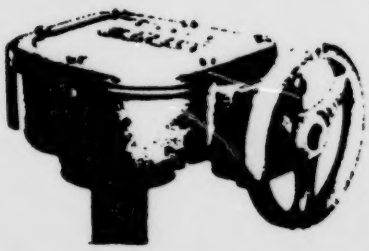
Ordering Rotary Manual Actuators
To order rotary manual actuators, add the appropriate actuator number from the table below to the basic valve identification. Actuators can be mounted at 90° increments from standard as shown on page 13. Black area indicates disc position. Specify non-standard mounting positions below the valve and actuator identification.

CONSTRUCTION	ACTUATOR INPUT	ACTUATOR NUMBER
ENCLOSED		
CRANK	2"-6"	KEG3L
	8"-14"	KEG5L
	16"-20"	KEG7L
HANDWHEEL	2"-6"	KEG3H8 ●
	8"-14"	KEG5H12
	16"-20"	KEG7H16
CHAINWHEEL	2"-6"	KEG3W8
	8"-14"	KEG5W12
	16"-20"	KEG7W12
WEATHERPROOF		
CRANK	2"-6"	KWG3L
	8"-14"	KWG5L
	16"-20"	KWG7L
HANDWHEEL	2"-6"	KWG3H8
	8"-14"	KWG5H12
	16"-20"	KWG7H16
2" SQUARE NUT	2"-6"	KWG3N
	8"-14"	KWG5N
	16"-20"	KWG7N
WEATHERPROOF (BURIABLE)		
2" SQUARE NUT	2"-6"	KBG3N
	8"-14"	KBG5N
	16"-20"	KBG7N

FIG 624, 102 Chain For use with chainwheel actuators above. Order as a separate item by giving "FIG 624, 102" with length below.

Galvanized Chainwheel and Guide Same as chainwheel above except chainwheel and guide are galvanized.

2"-20" electric motor actuators

ACTUATOR SPECIFICATIONS

Actuator Type
RCS Motor Actuators with brake.

Speed of Operations
Speeds

2"-4"	30 seconds (KMGM2 and KMGM3)
5"	30 seconds (KMGM3) 15 seconds (KMGM4) 30 seconds (KMGM5)
6"	15 seconds (KMGM4) 30 seconds (KMGM5 and KMGM6)
8"	30 seconds (KMGM6 and KMGM7)
10"	30 seconds (KMGM7)
12"	30 seconds (KMGM7) 26 seconds (KMGM8)
14"	26 seconds (KMGM8)
16"	26 seconds (KMGM8) 55 seconds (KMGM9)
18"-20"	55 seconds (KMGM9)

See chart below.

Motor Enclosure
NEMA 4 Watertight (Standard).
NEMA 7 available on request.

Motor Electrical Characteristics
Standard — 120 VAC 60/50 Hz, 1 phase a.c.

Optional — 220 VAC 60/50 Hz, 1 phase a.c. (MAR25, 50, 90, 100, 160, 250, 800 and 1600); 220/440 VAC, 3 phase a.c. (MAR100, 160, 250, 800 and 1600)

Manual Valve Operation
Motor back shaft provided for wrench operation. Safety interlock cap cuts motor power when removed.

Limit Switches
Two standard adjustable open and close limit switches are located within the motor unit.
15 amps, ½ hp, 125 or 250 VAC
5 amps, 120 VAC "L" (Lamp Load)
½ amp, 125 VDC
¼ amp, 250 VDC

Accessories
Position Indicating Switches
2 optional switches can be added.
Standard switches are SPDT.
Consult factory for DPDT and 3PDT switches or for more than two extra switches.
Extra switches furnished on same Cam as standard.
Auxiliary switches furnished on separate Cam.
Potentiometer
Furnished mounted in the limit switch case. Approximately 90° valve rotation from open to closed provides usable potentiometer output signal span of approximately 1,000 ohms. To order, add code "R" to actuator identification.
Breather and drain
For applications that are exposed to high humidity; breathers and drains are recommended for explosion-proof actuators.
Heater and Thermostat
For applications that are exposed to high humidity, or extreme low temperature, heaters and thermostats are recommended.
Extended Duty Motor
All standard units are rated for 25% duty cycle. When ordering extended duty units it is recommended that DeZURIK be consulted to determine the correct cycle time for particular applications.

Actuator Ordering
To order electric motor actuators, add the appropriate actuator model number from the sizing table below and the electric characteristics code as follows to the basic valve identification. Actuators can be mounted at 90° increments clockwise from standard. Specify non-standard mounting positions below the valve and actuator identification.

Electrical Characteristic Code:
A = 120 VAC 60/50 Hz, 1 phase a.c.
B = 220 VAC 60/50 Hz, 1 phase a.c.
C = 220/440 VAC, 3 phase a.c.

ORDERING EXAMPLE:
0800, FIG 832, W, B, RS16, 2, KMGM6, A.

VALVE SIZE	25 PSI UNI-DIRECTIONAL SHUTOFF		
2"-5"	MAR25	(10)	KMGM2
6"	MAR50	(30)	KMGM3
8"	MAR100	(30)	KMGM5
10"	MAR160	(30)	KMGM6
12"-14"	MAR250	(30)	KMGM7
16"-20"	MAR800	(26)	KMGM8

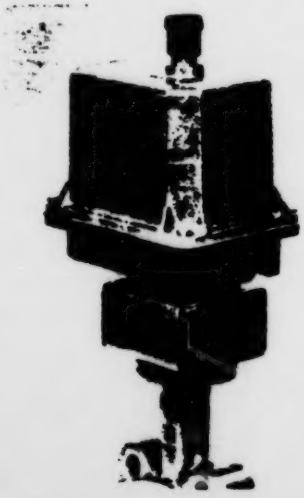
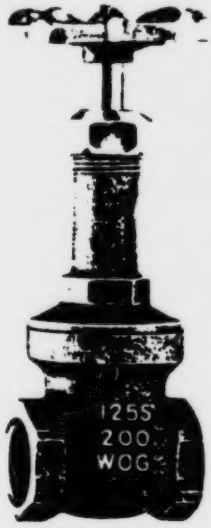
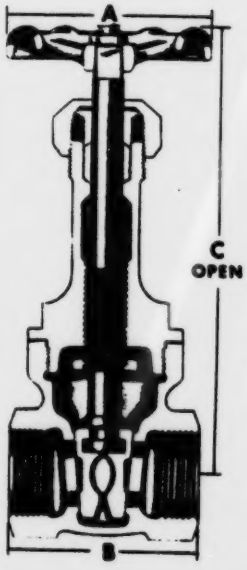


FIG 832 BUTTERFLY W/RCS MOTOR

VALVE SIZE	PRESSURE DROP, PSI						
	25	50	75	100	125	150	175
2"	KMGM2 MAR25 (10)						
2½"	KMGM2 MAR25 (10)					KMGM3 MAR50 (30)	
3"	KMGM2 MAR25 (10)			KMGM3 MAR50 (30)			
4"	KMGM2 MAR25 (10)		KMGM3 MAR50 (30)				
5"	KMGM3 MAR50 (30)		KMGM4 MAR90 (15)		KMGM5 MAR100 (30)		
6"	KMGM4 MAR90 (15)		KMGM5 MAR100 (30)			KMGM6 MAR160 (30)	
8"	KMGM6 MAR160 (30)		KMGM7 MAR250 (30)				
10"	KMGM7 MAR250 (30)						
12"	KMGM7 MAR250 (30)		KMGM8 MAR800 (26)				
14"	KMGM8 MAR800 (26)						
16"	KMGM8 MAR800 (26)		KMGM9 MAR1600 (55)				
18"	KMGM9 MAR1600 (55)						
20"	KMGM9 MAR1600 (55)						

NOTE: Number in parentheses indicates operating speeds for 90° rotation. (60 cycle motors only; 50 cycle motors increase in time by a factor of 1.2.)





No. 440

RISING STEM

SPLIT WEDGE

WORKING PRESSURES
NON-SHOCK

125 psi Steam, Basic Rating

200 psi Cold Working Pressure

FEATURES:

Double Wedge Disc made in two pieces, operates by means of a spherical joint that self-aligns the disc faces as they are thrust against the tapered seats by the last turn of the handwheel. Long and accurate guiding prevents contact of the seating surfaces until the instant of closing, eliminating drag and wear.

Rising-Stem provides positive indication of disc position.

Threaded Ends in Accordance with ANSI B2.1

Cylindrical-Shaped Body is the strongest and most successful design for withstanding internal pressure and line strains. The extra rigidity imparted by this shape reinforces the seats against the wedging action of the disc and distortion from line strains.

Deep Stuffing Boxes are precision machined and filled with high grade packing to ensure a tight stem seal.

Back-Seating Stem enables valve to be repacked under pressure in fully opened position.

Large End Hexagons provide generous wrench grip area and add reinforcement against body distortion from line strain.

ASTM B62 Bronze (85-5-5-5) ensures a high strength body casting.

Additional features on page 10.

RECOMMENDATION:

Double disc valves should be installed in an upright position, the stem being vertical.

DIMENSIONS AND WEIGHTS
INCHES (MILLIMETRES) — POUNDS (KILOGRAMS)

440	¼ (6)	⅜ (10)	½ (15)	¾ (20)	1 (25)	1¼ (32)	1½ (40)	2 (50)	2½ (65)	3 (80)
A	1.75 (44)	1.75 (44)	2.37 (62)	2.37 (60)	2.75 (70)	3.00 (76)	3.71 (94)	4.50 (114)	5.00 (127)	5.00 (127)
B	1.56 (40)	1.64 (42)	1.90 (48)	2.14 (54)	2.47 (63)	3.08 (78)	3.11 (79)	3.39 (86)	4.28 (108)	4.59 (117)
C	4.75 (121)	4.75 (121)	5.37 (137)	6.37 (162)	7.43 (189)	8.87 (226)	10.00 (254)	11.93 (303)	14.67 (376)	16.43 (417)
Wts.	.66 (.30)	.66 (.30)	1.0 (.46)	1.6 (.73)	2.3 (1.1)	3.4 (1.5)	4.3 (2.0)	6.8 (3.1)	10.2 (4.6)	16.6 (7.5)

Volume

2

CONTRACT SERIAL NO: OSQ83-00286

REQ'N NO: 23440-3-9049

TITLE: DESIGN AND DEVELOPMENT OF A FINE COAL CLEANING MOBILE PLANT: VOLUME II (Phase III)

CONTRACTOR: FENCO ENGINEERS INC.

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SECTION 7

STRUCTURAL DETAILS AND DRAWINGS

7.0 STRUCTURAL DETAILS AND DRAWINGS

The following drawings are included in this section:

42022 J-01	Base Plan Framing Plan General Notes
42022 J-02	Cross Sections
42022 J-03	Equipment Subframe Details
42022-J-04	Static & Operating Loads for Structural Design Plan on Floor Level & Section 'A-A' Process Option 1, 2 & 3
42022-J-05	Static & Operating Loads for Structrual Design Plan on Top Level & Section 'B-B' Process Option 1, 2 & 3
42022-J-06	Static & Operating Loads for Structural Design Plan on Floor Level & Section 'A-A' Process Option 4 to 7
42022-J-07	Static & Operating Loads for Structural Design Plan on Top Level & Section 'B-B' Process Option 4 to 7

These drawings are self-explanatory and show all pertinent constructional details.

The trailer manufacturer will be responsible for designing the chassis and structural framing to suit the loading shown on our drawings.

The construction contractor will be responsible for checking and finalizing mounting details to suit the certified drawings of the proprietary equipment.

SECTION 8

ELECTRICAL DETAILS AND DRAWINGS

8.0 ELECTRICAL SPECIFICATION AND DETAILS

8.1 General

8.1.1 Power Distribution System

Power will be supplied to the mobile plant via 30 metres of portable power cable from an Owner supplied 480 volt or 600 volt, 3 phase, 3 wire, 100 amp fused disconnect switch to be located and installed by the Owner in the existing plant, and connected to the existing plants 3 phase grounded system.

Connections to the mobile plant distribution equipment will be made with a 3 phase, 3 wire weatherproof plug and recptable. Two such receptacles will be provided on the outside wall of the Electrical Control Module, one for power supplied an 480 volts and one for power supplied at 600 volts.

The 600 volt supply will be connected to an autotransformer having 600 volt primary and 480 volt secondary windings which shall be connected via a manually operated fused transfer switch to the 480 volt busbars of the motor control centre.

The 480 volt supply will be connected to the 480 volt busbars of the motor control centre also via the same manually operated fused transfer switch so that either voltage level of power supply can be selected as indicated on Drawing No. 42022-E-01, Single Line Diagram.

Main operating voltage for the mobile plant will be 480 volt, 3 phase, 60 Hz with all motors rated at 460 volts, except variable speed motors rated at 230 volts and single phase motors rated at 115 volts.

All electrical distribution and motor control equipment will be installed in the Electrical Control Module with the exception of three Module Starter

Panels, for the removable flotation cells bank modules, which will be located on the permanent section of the mobile plant adjacent to the removable modules they supply, and two distribution transformers which will be located outside and close to the Electrical Control Module shown on Drawing No. 42022-E-05. The Electrical Control Module, located at one end of the mobile plant, will be a steel framed, metal clad, insulated enclosure provided with electric heating, ventilation and air conditioning to suit the requirements of the Central Control System.

Main electrical distribution and motor control equipment to be located within the Electrical Control Module as shown on Drawing No. 42022-E-05 will be as follows:

a) 480 volt Motor Control Centre for the control of all 460 volt, 3 phase, 60 Hz motors.

b) 240 volt Motor Control Centre for the power supply and sequencing of the regulated speed drive units for the 230 volt, 3 phase, 60 Hz variable speed pump motors.

c) 120 volt Starter Panel for the control of all 120 volt, 1 phase, 60 Hz motors.

d) Solid State Variable Frequency Drive Panels for the speed control of the variable speed pump motors.

e) Electronic Drive Units for the reagent pumps.

f) 120/240 volt Panelboard and Transformer for lighting, receptacles, control power supply, etc.

All motors and electrical control devices permanently installed on the mobile plant will be directly connected to their respective starter or control panel.

Motors and electrical control devices installed on interchangeabl plant modules will be connected to their respective starters via weatherproof plugs and receptacles. The receptacles will be directly connected to the starter or control panel and will be located on the permanent section of the mobile plant adjacent to the interchangeable module they supply.

All permanent power, control and instrumentation cables and wire will be installed in rigid galvanized steel conduit.

Motors, enclosures housing electrical devices and steel frames will be solidly grounded to the main ground busbar located in ths 480 volt Motor Control Centre as shown on Drawing No. 42022-E-05.

Each item of electrical equipment on interchangeable plant module will be grounded through an additional grounding pole in the respective plug and receptacle back to the ground busbar in their starter enclosure or control panel.

The main ground busbar in the 480 volt Motor Control Centre will be connected to the existing plant ground loop via a fourth ground conductor in the portable cable supplying the mobile plant.

8.1.2 Control System

To facilitate the various plant operating options, sequencing control of all electrically driven equipment will be provided by the Central Control System (CCS).

The CCS will be programmed for each of the process options indicated on the sequence diagrams, with interface contacts for start/stop and permissive wired in accordance with the typical elementary diagrams shown on Drawing No. 42022-E-03 and block control diagram Drawing No. 42022-E-04.

Initiation of the option selection and system start or stop in addition to individual equipment operation for test and maintenance will be accomplished using the CCS keyboard.

Sequential control will be mainly "in-line" type sequencing with the initiation of equipment start being confirmed before initiation of the start of the next equipment in that particular sequence.

Two exceptions are required to the normal start/stop sequencing. The flotation cell bank modules will be operated as single units with start/stop for each cell bank controlled by a contactor located in the 480 volt Motor Control Centre. Failure of any of cell drive motors will alarm only but not shut down the flotation cell bank module. Failure of either of the paddle drive motors on a flotation cells bank module however will shut down the entire cell bank module.

The variable speed pump drives will require a two stage start-up, first to initiate the power supply to the variable frequency drive panel from a contactor located in the 240 volt Motor Control Centre and secondly initiate the start of the pump to the variable frequency drive panel.

Inputs and outputs for the CCS required for the sequential control of the electric drives are as follows:

Inputs		Outputs
Pump #1 Run Permissive	----------	Power to Pump #1
Pump #2 Run Permissive	----------	Power to Pump #2
Pump #3 Run Permissive	----------	Power to Pump #3
Pump #4 Run Permissive	----------	Power to Pump #4
Pump #5 Run Permissive	----------	Power to Pump #5
Pump #6 Run Permissive	----------	Power to Pump #6
Pump #7 Run Permissive	----------	Power to Pump #7
None	----------	Start/Stop Pump #1
None	----------	Start/Stop Pump #2
None	----------	Start/Stop Pump #3
None	----------	Start/Stop Pump #4
None	----------	Start/Stop Pump #5
None	----------	Start/Stop Pump #6
None	----------	Start/Stop Pump #7
None	----------	Freq. Adj. Signal Pump #1 (4-20 ma)
None	----------	Freq. Adj. Signal Pump #2 (4-20 ma)
None	----------	Freq. Adj. Signal Pump #3 (4-20 ma)
None	----------	Freq. Adj. Signal Pump #4 (4-20 ma)
None	----------	Freq. Adj. Signal Pump #5 (4-20 ma)
None	----------	Freq. Adj. Signal Pump #6 (4-20 ma)
None	----------	Freq. Adj. Signal Pump #7 (4-20 ma)
Desliming Screen Running	--------	Start/Stop Desliming Screen
Sizing Screen Running	----------	Start/Stop Sizing Screen
Dewatering Screen #1 Running	----	Start/Stop Dewatering Screen #1
Dewatering Screen #2 Running	----	Start/Stop Dewatering Screen #2
Screw Convr. #1 Running	--------	Start/Stop Screw Convr. #1
Screw Convr. #2 Running	--------	Start/Stop Screw Convr. #2
Froth Pump #1 Running	----------	Start/Stop Froth Pump #1
Froth Pump #2 Running	----------	Start/Stop Froth Pump #2
Flotation Cell Bank #1 "On"	-----	Start/Stop Flotation Cell Bank #1

Flotation Cell Bank #1 ---------- None
Mtr. 1 Tripped.
Flotation Cell Bank #1 ---------- None
Mtr. 2 Tripped.
Flotation Cell Bank #1 ---------- None
Mtr. 3 Tripped.
Flotation Cell Bank #1 ---------- None
Mtr. 4 Tripped.
Flotation Cell Bank #1 ---------- None
Mtr. 5 Tripped.
Flotation Cell Bank #1 ---------- None
Paddle Mtr. #1 Tripped.
Flotation Cell Bank #1 ---------- None
Paddle Mtr. #2 Tripped.
Flotation Cell Bank #2 "On" ----- Start/Stop Flotation Cell Bank #2
Flotation Cell Bank #2a --------- None
Mtr. 1 Tripped.
Flotation Cell Bank #2a --------- None
Mtr. 2 Tripped.
Flotation Cell Bank #2a --------- None
Mtr. 3 Tripped.
Flotation Cell Bank #2a --------- None
Mtr. 4 Tripped.
Flotation Cell Bank #2a --------- None
Mtr. 5 Tripped.
Flotation Cell Bank #2a --------- None
Paddle Mtr. #1 Tripped.
Flotation Cell Bank #2a --------- None
Paddle Mtr. #2 Tripped.
Flotation Cell Bank #2b --------- None
Mtr. #1 Tripped.

Flotation Cell Bank #2b --------- None
Mtr. #2 Tripped.
Flotation Cell Bank #2b --------- None
Mtr. #3 Tripped.
Flotation Cell Bank #2b --------- None
Mtr. #4 Tripped.
Flotation Cell Bank #2b --------- None
Mtr. #5 Tripped.
Flotation Cell Bank #2b --------- None
Paddle Mtr. #1 Tripped.
Flotation Cell Bank #2b --------- None
Paddle Mtr. #2 Tripped.
Froth Cell Blower Running ------- Start/Stop Froth Cell Blower
Reagent Pump #1 Running --------- Start/Stop Reagent Pump #1
Reagent Pump #2 Running --------- Start/Stop Reagent Pump #2
Reagent Pump #3 Running --------- Start/Stop Reagent Pump #3
Reagent Pump #4 Running --------- Start/Stop Reagent Pump #4
Reagent Pump #5 Running --------- Start/Stop Reagent Pump #5
Reagent Pmmp #6 Running --------- Start/Stop Reagent Pump #6
Reagent Pump #7 Running --------- Start/Stop Reagent Pump #7
Reagent Pump #8 Running --------- Start/Stop Reagent Pump #8
Reagent Pump #9 Running --------- Start/Stop Reagent Pump #9
Reagent Pump #10 Running -------- Start/Stop Reagent Pump #10
Reagent Pump #11 Running -------- Start/Stop Reagent Pump #11
Reagent Pump #12 Running -------- Start/Stop Reagent Pump #12
Reagent Pump #13 Running -------- Start/Stop Reagent Pump #13
Conditioner #1 Running ---------- Start/Stop Conditioner #1
Conditioner #2 Running ---------- Start/Stop Conditioner #2

Five "Emergency Stop" pushbutton stations will be provided, one located at the CCS in the Electrical Control Module and one at each corner of the operating plant as shown on Drawing No. 42022-E-05.

The emergency stop system relays will be located in one isolated section of the 240 volt Motor Control Centre. All emergency stop relay contacts will be "hard" wired into starter control circuits as shown on Drawing No. 42022-E-03 to ensure a positive shutdown of all plant under emergency stop conditions.

8.1.3 Lighting System

General lighting will be provided by incandescent lighting fixtures utilizing shock resistant lamps. Fixtures in the equipment area of the mobile plant will be provided with guards and will be located on the permanent structure as shown on Drawing No. 42022-E-06. Receptacle outlets will be weatherproof type in all areas external to enclosed modules.

8.2 Basic Materials and Methods

8.2.1 General

All equipment and materials are to be installed on a portable trailer plant and will therefore be subject to extreme vibration when transported from site to site. The Contractor shall ensure that the installation of all equipment and materials are securely bolted or welded to the mobile plant structural members to prevent damage or vibrating loose under these conditions.

All layouts and arrangements are based upon specific manufacturers, as indicated on the drawings. The Contractor shall verify the dimensions of all equipment supplied, or in his supply, to ensure that adequate space is available for the installation as indicated on the drawings.

The following lists equipment specified in other Sections:

a) Central Control System.
b) Instrumentation process control devices.
c) Variable Frequency Control Panels.
d) Reagent pump electronic drives.

All designs, equipment and materials will conform to the applicable requirements of the latest edition of the Canadian Standards Association, Standard C22.1 Canadian Electrical Code Part 1, and any other authority having jurisdiction over the equipment.

Names and abbreviations used through the Specifications are:

EEMAC Electrical and Electronic Manufacturers Association of Canada (formerly CEMA)

CSA Canadian Standards Association

NEMA National Electrical Manufacturers Association (U.S.)

CEC Canadian Electrical Code

8.2.2 Disconnect Switches

Disconnect switches shall be fusible or non-fusible, front-operated, heavy duty, industrial, quick-make, quick-break, horsepower rated type with provision for padlocking in the "Off" position.

Fusible switches shall be supplied with fuse holders to accept HRC Form 1 Class J fuses.

Enclosures for all disconnect switches shall be finished in ASA #61 light grey enamel.

Voltage, ampacity, number of poles and neutral and terminal lug requirements shall be as shown on the drawings.

Enclosures of surface-mounted disconnect switches shall be EEMAC 1 in the Electrical Control Module and EEMAC 4/12 suitable for Class 2, Div. 2, Group F for all other areas.

Disconnect switches shall be of one of the following manufacturers:

Square D
Westinghouse Canada Ltd.
Allen Bradley
Canadian General Electric

Disconnect switches for fractional horsepower 120 volt motors shall be heavy duty, specification grade, single pole, 20 amp, 120 volt AC, toggle type, of bakelite construction with terminals suitable for side or back wiring and shall be of one of the following manufacturers:

Arrow-Hart
Canadian General Electric
Hubbell
Bryant

8.2.3 Motor Starters and Contactors

Manual motor starters for motors shall be single or multi-pole as indicated, quick-make, quick-break, manual reset, trip indicating handle, with one overload device in each ungrounded phase conductor. Starters shall be toggle operated with one normally open auxiliary contact and shall be manufactured by one of the following:

Allen-Bradley
Canadian General Electric
Westinghouse Canada Ltd.
Square D

Magnetic, squirrel cage induction motor starters shall be full voltage, door interlocked circuit disconnect device combination, electrically held type. Each starter shall have three phase thermal overload (bi-metallic) protection for three phase motors and one thermal overload device for each ungrounded phase conductor for single phase motors. The contactor shall be electrically interlocked and electrically maintained. The circuit disconnecting means shall be a fusible disconnect switch. Fused switches shall be suitable for HRC Form I Class J fuses. Starters shall be complete with a secondary fused 120 volt control transformer and a minimum of one one spare normally open and one spare normally closed auxiliary contact. Overload devices to be resettable from outside of enclosure.

Contactors shall be the same as magnetic starters but without thermal overload devices.

Starters and contactors shall be rated for system fault capacity specified on the drawings.

Magnetic starters and contactors shall be of one of the following manufacturers:

Allen-Bradley
Canadian General Electric
Westinghouse Canada Ltd.
Square D

8.2.4 Motor Control Centres

The motor control centres (MCC) shall be suitable for use on a 480 volt or 240 volt, 3 phase, 3 wire, 60 Hz, solidly grounded system having a maximum symmetrical 3 phase available fault level of 42,000 amperes.

Each control centre shall comprise the required number of modular compartmented vertical sections joined together to form a rigid, free-standing, dead-front EEMAC-1 type enclosed structure.

Each vertical section shall be nominally 15 inches deep, 20 inches wide and 90 inches high, and shall be fabricated of steel. The vertical sections shall be assembled together on common steel channel mounting sills to facilitate handling and installation, running along the front and back at the bottom of the complete structure.

Each vertical section shall contain two compartments for use as horizontal bus and wiring troughs. One compartment shall be located in the front at the top of the section and the other in the front at the bottom. In addition, each section shall contain on the top two cutouts with removable covers for access to the main bus, and a cutout with a removable cover on each side at the top and bottom for horizontal wiring. A full height vertical wiring trough with cable supports shall be provided in each vertical section for unit wiring; it shall be minimum 3 inches in width and be complete with cable tie clamps.

Wireways and troughs shall be separated from bus spaces and control units by isolating barriers, removable for wiring.

The MCC shall be completely front accessible and suitable for mounting against the building walls.

Each unit requiring accessibility to controls shall have a flange formed door with concealed hinges in the front. The doors shall be hinged to the structure and secured with knurled head thumb screws. The remainder of the compartments, including unused compartments, shall contain flanged form covers secured with pressure type fasteners. All compartments shall be separated by isolating barriers, removable for wiring.

The heights of each compartment shall be multiples of a common dimension, making all units readily interchangeable. No more than six compartments to be used for control units shall be stacked in each vertical section.

Each motor control centre shall be identified as shown on the drawings. The arrangement of starters and fuse switches shall be subject to the Owner's approval.

Each control unit shall be mounted with all its components on a steel mounting plate which shall be standardized and interchangeable. All unit components shall be removable and accessible from the front. They shall be front-connected and shall be readily convenient to wire each unit in position in its compartment. Means shall be provided for supporting, grounding and aligning the unit in its compartment during its removal or replacement. Each control unit shall be connected to the vertical bus by means of "stab-on" connectors.

The individual unit equipment is to be designed to ensure that ample space is available inside the unit to avoid tripping of thermal protection devices and damage to component parts due to overheating.

A horizontal main power bus rated not less than that shown on the drawings shall be continuous within each section. Vertical branch busses of 300 ampere continuous rating shall be provided in the full height of each vertical section.

The horizontal bus shall consist of reactangular copper, be tin-plated and supported on each section by means of insulated supports. The vertical copper bus shall be tin-plated and supported behind each unit by means of insulated supports.

Bus supports shall be formed of high dielectric strength, low moisture absorption, high impact material with ample creepage surface.

A horizontal copper ground bus shall be provided along the complete length of the structure, securely bonded to each vertical section. The bus shall be continuous within each shipping section. A two-hole mechanical connector is required at both ends of the ground bus.

The wiring arrangement for all MCC's shall be EEMAC Class 1, Type B with all control connections to be brought to terminal blocks within each starter compartment. A minimum of 6 spare terminal blocks shall be provided for Owner's #12 AWG incoming control wiring.

Incoming and outgoing power cables and conduits shall enter the MCC's from the top.

Provision shall be made for field installation of control wiring between vertical sections.

All internal wiring shall employ stranded copper conductors.

Wires shall be colour coded as follows:

Facility	Colour	Circuit
Control	Red	AC
Power	Black	AC

Terminal blocks shall be of the compression type and shall be of modular construction, enabling individual terminals to be taken from or added to any terminal block arrangement. All terminal blocks shall be identified with numbers identical to the wire numbers.

No more than two wires shall be placed under each terminal screw. Both terminals of a remote interlock shall be brought to the MCC.

Three types of external nameplates shall be provided with each MCC:

a) A lamacoid nameplate with 1 inch black letters on a white background shall be mounted centrally on both sides for identification of the MCC.

b) A laminated phenolic warning sign with 1/2 inch white letters on a red background shall be mounted on the front of the main feeder compartment to identify the power source.

c) One 3-1/2 x 1-1/2 inch laminated phenolic nameplate with 1/4 inch black letters on a white background shall be mounted on the door of each control or switching unit compartment, identifying starter or contactor function as per single line diagram.

The pressure type cable lugs, bus adapters and extensions shall be suitable for terminating the main incoming cable conductors. The lugs shall accommodate the number and size of cables as shown on the drawings. Cable entry shall be from the top.

All motor starter units shall be of the combination magnetic type, full voltage, non-reversing (FVNR) comprising a 3 pole, 480 volt or 240 volt circuit protective device and a magnetic starter.

Each starter shall contain a 120 volt AC operating coil and three adjustable, manually resettable, ambient compensated, bimetallic type overload relays,. A "Stop-Reset" pushbutton for the overload relays shall be mounted on the starter door. Individual starters shall be equipped with a single 480-120 volt or 240-120 volt control transformer with the 120 volt winding fused and grounded. Each starter contactor shall be furnished with one normally open and one normally closed 120 volt auxiliary interlock contacts, wired to the terminal blocks.

The overload relay heaters for all motor starters shall be included.

The circuit protective device shall be a fusible disconnect switch, 3 pole, 480 volt or 240 volt, and rated for system fault levels of 42,000 amp symmetrical.

Where physically possible, all combination starters shall be the drawout type, and shall be interchangeable with those units having similar control functions with the possible exception of dissimilar overload elements.

The minimum starter size used shall be EEMAC Size 1.

The external operating handle of each circuit protective device shall be interlocked with the unit door so that the handle must be in the "Off" position before the door can be opened. The handle shall be arranged for padlocking in either "On" or "Off" position with one padlock.

Fuses for fusible disconnect gear shall be HRC type, Form I, Class J.

The distribution transformer shall be a single phase 480-12-240 volt dry type with primary fused disconnect switch suitable for mounting within a vertical section of the motor control centre.

The lighting panelboard shall be a circuit breaker type 120/240 volt, 3 wire, dead front safety type, equipped with double or single row thermal magnetic, non-interchangeable bolt-on molded case brance circuit breakers of sizes indicated on the drawing. The panelboard shall be suitable for mounting within a vertical section of the motor control centre. Circuit breakers for general purpose receptacle circuits shall be the ground fault type.

Painted surfaces of the equipment shall be ground smooth, thoroughly cleaned, etched in a phosphate solution and coated with a rust-inhibiting primer. The finish coat shall be ASA 61 light grey enamel. The interior shall be a white finish.

Motor control centres shall be of one of the following manufacturers:

Allen-Bradley
Canadian General Electric
Westinghouse Canada Ltd.
Square D

8.2.5 Control Relays

Control relays shall be general purpose, heavy duty industrial type with 120 volt AC coil and 10 amp rated contacts.

Control relays shall contain from four to eight normally open convertible contacts as indicated on the drawing.

Relays shall be of one of the following manufacturers:

Canadian General Electric
Allen-Bradley
Westinghouse Canada Ltd.

8.2.6 Operator Pushbutton Stations (Emergency Stop)

Pushbuttons, shall be heavy duty, oil-tight type for mounting in covers of control station enclosures.

Pushbuttons shall be the maintained contact type push-pull type with "Red" mushroom head.

Enclosures shall be EEMAC 4/12 suitable for Class 2, Div.2; Gr.F. Enclosures for all operator control stations shall be finished in ASA #61 light grey enamel.

Pushbuttons shall be of one of the following manufacturers:

Allen-Bradley
Square D
Canadian General Electric
Westinghouse Canada Ltd.

8.2.7 Motor Starter Panels

Motor starter panels shall be shop fabricated from prime quality cold rolled steel, properly formed and suitably reinforced to provide adequate strength.

Doors shall be provided with continuous piano hinges permitting access to all internal components and wiring. Provision shall be made for padlocking the enclosure.

The 120 volt starter panel shall be of EEMAC Type 1 general purpose construction with inner panel for installation in the electrical control module.

The 480 volt starter panels shall be of EEMAC Type 4/12 dust-tight and water-tight construction with inner panel and permanently secured oil-resistant neoprene gasket, suitable for installation in a Class 2, Division 2, Group F outdoor location.

The panel finish shall be phosphatized, primed and painted with ASA #61 grey enamel on the outside.

All electrical equipment shall be mounted on the inner panel, identified with engraved nameplates and prewired to identified terminal blocks as indicated on the drawing.

Nameplates shall be laminated phenolic black letters on white background with minimum of 1/4 inch letters and shall be securely fastened to the inner panel with stainless steel screws.

All wiring within the starter panels shall be arranged systematically so that all circuits can be readily traced.

Wire runs up to ten conductors may be tie-wrapped. For wiring installations exceeding ten conductors, plastic wire ducts with covers shall be used.

Terminal block terminations shall be provided for all outgoing wiring connections and spare terminals totalling at least 25% of those actually used shall be provided.

All wiring at both ends shall be identified with wire markers.

Wiring connection to terminal blocks shall be maximum of two wires per terminal. Bridge bars shall be used if more than two wire connections are required.

All terminal blocks shall be provided with clear plastic snap-on safety covers.

All wiring shall be stranded copper Type TEW, 105°C, 600 volt thermo-plastic insulation.

Minimum wire sizes and insulation colour:

Control wiring #14 AWG
- Green (ground)
- White (neutral)
- Red (phase)

Power wiring #12 AWG
- Black (phase)
- White (neutral)

A copper ground bus 1" x 1/8" shall be located on the inner panel.

8.2.8 Fuses

Unless otherwise indicated, all fuses shall be HRC (high rupturing capacity) with a fault capability of 200,000 amps symmetrical.

Fuses to be Form I, Class J, fast acting up to 600 amp rating.

All fuses to be product of one manufacturer.

Fuses to be of one of the following manufacturers:

English Electric
Bussman
Aeroflex
Commercial Enclosed Fuse Co. (CEFCO)

8.2.9 Distribution Transformers

Transformers shall be general purpose, dry type, air cooled, low sound level with vibration isolators, copper windings, rating and voltages as indicated on the drawings. A minimum of one 5 percent primary tap above and below rated voltage shall be provided and brought out to identified terminal boards. Winding insulation shall be Class F with Class F (115°) temperature rise. Primary windings shall be delta connected, secondary windings shall be star connected with provision for grounding of neutral.

Transformers shall be finished in ASA #61 light grey enamel.

Enclosure shall be non-ventilated with epoxy encapsulated core and coil assembly.

Transformers shall be as manufactured by:

Hammond
Westinghouse Canada
Canadian General Electric

8.2.10 Convenience and Power Receptacles

Convenience outlet receptacles installed in enclosed modules shall be heavy duty, specification grade, duplex, 3 wire grounding, 15 amp, 120 volt AC, brown bakelite, with terminals suitable for side or back wiring and break-off fin for two-circuit use and shall be of one of the following manufacturers:

Hubbell
Arrow-Hart
Canadian General Electric
Bryant

Convenience outlet receptacles installed in any area outside the enclosed modules shall be heavy duty two gang, 3 wire grounding, 15 amp 125 volt A.C. factory sealed type complete with back box and spring loaded covers.

Crouse-Hinds ENR

Panel mounted receptacles for motors requiring 480 volt, 3 phase supply shall be heavy duty, locking and grounding, 3 phase, 20 amp, 4 wire, flanged type with pressure type terminals and shall be of one of the following:

Hubbell #2436
Bryant #71620ER
Arrow-Hart #6436

Receptacles for motor requiring 480 volt, 3 phase supply which are not panel mounted shall be similar to panel mounted type except not flanged type and shall be of one of the following:

Hubbell #2430
Bryant #71620FR
Arrow-Hart #6430

Receptacles for main incoming power shall be heavy duty, single, 4 wire, 4 pole, 100 amp, 600 volt AC, black bakelite locking type with pressure type terminals complete with back box and angle adaptor and shall be one of the following:

Crouse-Hinds #AREA 10485
Killark #WRACS-51004

All 3 phase receptacles are to be supplied with matching plugs complete with weatherproof cover.

8.2.11 Wall and Cover Plates

Cover plates for surface mounted receptacles within enclosed modules shall be cast ferrous alloy.

Cover plates for all other receptacles shall be weatherproof with spring loaded covers.

8.2.12 Air Conditioner

The air conditioner shall be an individual wall mounting unit with a cooling capacity of 1900 watts, 6500 Btu/h, fan capacity of 180 cfm, and moisture removal of 2 pints per hour with outdoor temperature of 35°C and 24°C WB.

Controls shall be factory wired and completely enclosed within unit. All operating controls shall be located in one area of the front of the unit.

The compressor motor shall be two pole, permanent split capacitor type with both thermal and overload protection.

The unit shall be suitable for operating on a 240 volt, single phase 60 Hertz supply.

Air deflectors shall be variable to permit adjustment of air flow direction.

The unit shall be of the following manufacture or approved equal.

Carrier "Siesta" #51BK0077

8.3 Conduits, Fittings and Electrical Boxes

8.3.1 General

The raceway systems shall be comprised of conduits, fittings, supports, hangers and miscellaneous support materials suitable for Class 2, Div. 2., Gr.F. location.

Flexible liquid-tight conduit shall be used between the rigid conduit system and any equipment subject to vibration or adjustment such as motors.

8.3.2 Rigid Steel Conduit

Rigid steel conduit, including elbows and fittings, shall be hot dip galvanized inside and outside, as manufactured by:

Canadian General Electric
Westinghouse Canada Ltd.
Conduits National

8.3.3 Liquid-Tight Conduit

Liquid-tight flexible conduit shall be of aluminum or galvanized steel, spirally wound interlocked armour construction, extruded PVC jacket overall, CSA certified, as manufactured by:

Anaconda Metal Hose "Sealtite"

8.3.4 Conduit Fittings

Conduit straps for steel conduit shall be malleable iron, hot dip galvanized, single hole type.

Beam clamps shall be hot dip galvanized steel or malleable iron, as manufactured by:

Thomas and Betts
Efcor
Swift

Connectors for rigid steel conduit shall be of malleable iron or steel and shall incorporate nylon insulated throat or bushing. Hub type connectors, nylon insulated with recessed neoprene "O" ring shall be provided for connections to enclosures in wet or outdoor areas. Pressure type terminals shall be provided when required for grounding wire connections.

Thomas and Betts
Efcor
Swift

Connectors for liquid-tight flexible conduit shall incorporate a threaded grounding core, nylon compression ring and gland. The connector shall have an insulated throat, male thread and locknut or male bushing with an integral "O" ring seal.

Thomas and Betts
Efcor

Locknuts shall be of the bonding type with sharp edges for digging into the metal wall of an enclosure.

8.3.5 Electrical Boxes

Surface-mounted outlet boxes and small junction and pull boxes 6" x 6" or smaller shall be cast rust-proof ferrous alloy with threaded conduit hubs and gasketed covers and manufactured by:

Appleton
Crouse-Hinds
Pyle National

Junction and pull boxes shall be galvanized steel with neoprene gasket and blank covers. Smaller boxes shall be provided with screw-mounted covers and captive non-corroding chain. Boxes sized 12" x 12" and larger shall be provided with piano type hinges. Junction and pull boxes shall be manufactured by:

Hammond
Taylor
C.E.B.

All outlet, junction and pull boxes shall be supplied with ground stud. Where ground stud is not provided by manufacturer, drill and tap enclosure housing and provide ground stud.

Surface-mounted outlet, junction and pull boxes shall be EEMAC 1 within Electrical Control Module.

Junction, outlet and pull boxes in all areas outside the Electrical Control Module shall be EEMAC 4/12 suitable for Class 2, Div. 2, Gr.F.

All junction boxes shall be provided with terminal blocks, number and ampere rating to suit circuit requirements. Terminal blocks shall be modular type, 600 volt rating, complete with mounting rail or bracket and insulated covers.

Allen-Bradley
Staffel
Electrovert Series 9700B

8.4 Wire and Cable

8.4.1 General

The wiring system shall include all wiring, wire markers, cable tags, table ties, splice fittings, insulating tapes, connectors and miscellaneous materials necessary to complete the wiring system.

Instrument wiring shall be separate from power and control wiring in accordance with recommendations in the Canadian General Electric "Drive System Wiring Practices" Bulletin #PGE1-1343B.

Terminations for portable cables shall be made with approved connectors suitable for the size and type of cable.

Portable flexible cables installed on portable units shall be arranged and installed in a secure and protected manner to a point on the portable unit nearest the "plug-in" point on the permanent mobile unit. Sufficient length of cable shall be left between the portable unit and the cable plug to reach the receptacle without undue strain on the cable.

8.4.2 Non-Armoured Wire and Cable

All non-armoured wire and cable shall have stranded, soft drawn copper conductors, 600 volt rate (minimum) for grounded systems, cross-linked polyethylene (XLPE) insulation (minus 40°C), 90°C maximum conductor temperature.

The wiring shall be suitable for installation in wet environment (RW-90).

Minimum conductor size shall be #14 AWG unless otherwise specified.

Multi-conductor cables where specified on the drawings or cable schedules shall be provided with interstitial fillers or an inner jacket of a suitable PVC (minus 40°C) or neoprene composition. A PVC (minus 40°C) flame retardant jacket shall be provided overall.

Use GTF fixture wire, 600 volt, 125°C, flexible copper conductor for all connections between lighting fixtures and outlet boxes.

Colour coding of insulated conductors shall conform to the following:

1-conductor power	-	Black (phase conductors), White (neutral)
2-conductor control	-	Red
2-conductor cable	-	Black, White
3-conductor cable	-	Red, Black, White
4-conductor cable	-	Red, Black, Blue, White
Multi-conductor cables	-	Manufacturer's standard

Insulated ground conductors forming part of a multi-conductor cable assembly shall have green colour coding.

Cable and wire shall be of one of the following manufacturers:

Northern Electric
Canadian General Electric
Westinghouse Canada Ltd.
Canada Wire and Cable
Phillips Cables Ltd.
Pirelli Cables Ltd.

8.4.3 Flexible Cables

All motor cables used on portable equipment shall have stranded flexible shoft drawn copper conductor, 600 volt rated, ethylene propylene rubber (EPR) insulation (minus 34°C), 90°C maximum conductor temperature with overall neoprene or hypalon jacket.

The cable shall be suitable for installation in outdoor wet environment, Type SOW.

Multi-conductor cables shall be used with minimum conductor Size #12 AWG.

Cable shall be of one of the following manufacturers:

Northern Electric
Canadian General Electric
Westinghouse Canada Ltd.
Canada Wire and Cable
Phillips Cables Ltd.
Pirelli Cables Ltd.

8.4.4 Portable Power Cable

Portable power feeder cable shall have stranded flexible soft drawn copper conductor, minimum 1000 volt rated, ethylene propylene rubber (EPR) insulation (minus 34°C), 90°C maximum conductor temperature with overall heavy duty neoprene jacket.

The cable shall be suitable for use in an outdoor wet environment, Type PG or equal.

The cable shall have three insulated phase conductors and one ground conductor of size equal to the phase conductors.

Cable shall be of one of the following manufacturers:

Northern Electric
Canadian General Electric
Westinghouse Canada Ltd.
Canada Wire and Cable
Phillips Cables Ltd.
Pirelli Cables Ltd.

8.4.5 Instrumentation Wiring

Instrumentation wiring shall be 300 volt minimum multi-conductor type with individually colour or number coded, insulated, stranded copper conductor, grouped in twisted pairs, triplets or quads. Each group shall be wrapped in an aluminum-polyester shield with bare stranded copper drain wire with an overall neoprene or chrome vinyl jacket of one distinctive colour.

Instrumentation wiring shall be of one of the following manufacturers:

Analog Signals:

Belden Cat. #8719 (twisted pair, 16 gauge)
Belden Cat. #8618 (twisted triplet, 16 gauge)
Belden Cat. #8407 (twisted quad., 16 gauge)

Digital Signals:

Belden Cat. #9773 (3 pair, 18 gauge)
Belden Cat. #9774 (6 pair, 18 gauge)
Belden Cat. #9775 (9 pair, 18 gauge)

8.4.6 Wiring Accessories

Plastic slip-on wire markers, black letters on white background, shall be of one of the following manufacturers:

Thomas and Betts	Shur-Code
Electrovert	Z-Type

Cable markers for cables or conductors greater than 0.50 inches diameter, shall be strap-on type, rigid PVC, black letters on white background, with PVC covered aluminum straps, as manufactured by:

Electrovert Cat. #510

Terminal blocks shall be 600 volt rated, sized to accommodate conductor size used as manufactured by:

Allen-Bradley
Staffel
Electrovert

Where screw-type terminals are provided on equipment, field wiring shall be terminated with insulated fork tongue terminals, as manufactured by:

Thomas and Betts	Sta-Kon
3M	Scotchlok

Connectors for wire sizes #14-10 AWG inclusive, shall be of the compression spring type, and one of the following manufacturers:

Marr	Marrette
Ideal	Wire-Nut
3M	Scotchlok

Connectors for wire sizes #8 AWG and larger shall be split-bolt type, sized to suit number and size of conductors. The connectors shall be of the following manufacture:

Burndy	Servit Type KS
Thomas and Betts	

Cable ties shall be nylon, one-piece, self-locking type by one of the following manufacturers:

Thomas and Betts
Burndy
Electrovert

Electrical insulating tape shall be of the following manufacture:

3M	Scotch 88

Cable connections to motor and electrical equipment on portable units shall be made using stainless steel cord connectors correctly sized for both conduit box entry and diameter of portable cable. Cord connectors shall be of one of the following manufacturers:

Hubbell
Thomas and Betts
Arrow-Hart

8.5 Grounding

8.5.1 General

The grounding system shall include all wiring, ground bus, thermit welds, mechanical splice fittings, connectors, links and miscellaneous materials necessary to complete the grounding system.

All joints, splices and tap connections on the ground conductor shall be permanent type made with thermit welds.

Ground connections to the trailer steel shall be made with pressure connectors and shall be located where they will not be subject to mechanical damage and, where possible, be accessible for inspection.

Ground connections shall be bolted directly to the steel and equipment using pressure connectors and 3/8 inch silicone bronze alloy bolts, the ends of which shall be peened after installation. Holes drilled through steel members shall not exceed 7/16 inch diameter.

Surfaces to which ground conductors or bus are to be bolted shall be cleaned of all paint, rust, etc., and both contact surfaces shall be lightly coated with an oxide-preventing agent before bolting connection to steel member.

Grounding conductors subject to mechanical damage shall be protected by rigid steel conduit or steel guard which shall be effectively grounded at both ends to the ground conductor they are protecting, regardless of their length.

Connections to ground bus shall be made using mechanical clamp type connectors.

Metal enclosures, motor frames, steel supports for starters, panels, switches, etc., which are not rigidly secured to and in contact with grounded structural steel or conduit system, or which are subject to excessive vibration, shall be securely bonded to building steel or conduit system with stranded copper conductors.

Ground wires forming an integral part of cables shall be bolted to equipment ground stud of enclosure at all terminations unless otherwise noted for single cables. Where stud is not provided, drill enclosure housing and install ground fitting.

Instrumentation cabling drain wires shall be connected to ground at one end (receiver) only. Where two or more drain wires are supplied in one cable, the wires shall be bonded together.

The neutral point of transformers shall be grounded to the ground bus of the MCC which they supply.

Ground continuity between outlet box and receptacle ground lug shall be provided by means of a bonding jumper.

Provide an insulated ground wire, having the same size as the phase conductor, in all raceways with the phase conductor. Bond the ground wire to equipment, receptacles and ground bus.

The neutral conductors must be fully insulated over their entire length and at all terminal points. The neutral for each system shall be grounded at one point only.

8.5.2 Ground Conductors

Ground conductors shall be concentric stranded, soft drawn copper. Insulated conductors, where required by inspection authorities or specified on the drawings, shall be Type TW, 600 volt rating, green colour.

8.5.3 Ground Connectors

Ground connectors, for connecting ground conductors to structural steel, ground busses and equipment shall be the pressure connector type, sized to accommodate the system ground conductor. Connectors shall be of the following manufacture:

Thomas and Betts
Burndy

8.6 Lighting System

8.6.1 General

The lighting and convenience receptacle system includes all luminaires, lamps, switching controls and receptacles.

The location of all luminaires and outlets as shown on the electrical plans is approximately correct at the time of design, but as these drawings do not show all structural details, measure any work requiring accurate dimensions on the project.

The mounting height of all lighting switches shall be 5 feet above floor level. Where more than one switch is installed in one location they shall be installed in a multi-gang box.

8.6.2 Lamps - Incandescent

Incandescent lamps shall be inside frosted, 100 watts, 120 volts with filament suitable for tough usage (resistant to physical shock).

Lamps shall be of one of the following manufacturers:

Phillips
Canadian General Electric
Sylvania

8.6.3 Switches

Lighting switches shall be heavy duty, specification grade, single pole, single or three position, 20 amps, 120 volts AC toggle, ivory bakelite, with terminals suitable for side or back wiring and shall be of one of the following manufacturers:

Hubbell
Arrow-Hart
Canadian General Electric

8.6.4 Wall and Cover Plates

Cover plates for switches with enclosed modules shall be cast ferrous alloy.

8.6.5 Luminaires

a) Type A

Incandescent lighting fixture enclosed, gasketed with heat resistant globe, 100 watt, for ceiling mounted supplied complete with box.

b) Type B

Similar to Type A except for wall mounting and supplied complete with guard.

c) Type C

Similar to Type B and supplied complete with white porcelain angle reflector.

Luminaires shall be of one of the following manufacturers:

Killark DV Series
Appleton VG Series
Crouse-Hinds

8.7 Motors & Motor List

8.7.1 General

This section covers the minimum requirements of small AC Induction Motors.

Motors shall be designed, manufactured and tested in accordance with the Requirements Standards and Codes of the following bodies:

Institute of Electrical and Electronics Engineering (IEEE)
National Electrical Manufacturers Association (NEMA)
American National Standards Institute (ANSI)
Canadian Standards Association (CSA)
Electrical and Electronic Manufacturers Association of Canada (EEMAC)

In the event of conflict, the most specific requirements shall apply.

A motor list and module utilization is included herein.

8.7.2 Basic Design

Motor performance shall meet EEMAC Design "B" requirements unless the requirements of the driven equipment dictate otherwise and approved by the Purchaser.

Motor shall be suitable for continuous duty in atmosphere normally associated with heavy industrial plants and for outdoor installation, through the range of outside ambient air conditions encountered at the plant location.

Motors shall be totally enclosed fan cooled (TEFC) and be capable of continuous full load operation in an ambient of 40°C without exceeding the specified temperature limits.

Integral horsepower motors shall have a 1.15 service factor and sized to meet the peak running load requirements without exceeding the nameplate horsepower.

8.7.3 Voltage Selection

Motor horsepower sizes shall be selected to operate at the following voltage levels unless otherwise specified:

Less than 1/2 HP:	120 volts, 1 phase, 60 Hz
1/2 through 200 HP:	480 volts, 3 phase, 60 Hz.

Motors for the variable speed pumps shall be selected to operate at 230 volts, 3 phase, 60 Hz.

8.7.4 Motor Starting

Motors shall be designed for across-the-line starting.

Motors shall be capable of starting and accelerating the specified load at 80% of motor nameplate voltage and at minimum ambient conditions.

8.7.5 Insulation

Motor insulation shall be Class B as defined in EEMAC standards. Temperature rise shall be limited to EEMAC Class B limits and for operation at altitude of 3300 ft. (1000 m) or less.

8.7.6 Enclosure

Enclosure parts shall be cast iron for integral horsepower motors.

Enclosure parts for fractional horsepower motor shall be cast iron or sheet steel not less than 1/8 inch thick.

Plugged drain holes shall be provided in motor enclosure at all points where water might collect.

8.7.7 Terminal Boxes

Terminal boxes shall be provided with a threaded conduit fitting. Boxes shall be rotatable for connection from any one of four directions at 90 degree intervals and shall be watertight.

Grounding terminal shall be provided in the terminal box securely bonded to the motor frame and suitable for terminating the feeder ground conductor.

8.7.8 Bearings and Lubrication

Bearings shall be grease lubricated anti-friction type.

Grease used for bearing lubrication shall have satisfactory lubrication qualities throughout the temperature range to be encountered by motors at the plant location.

Motors shall be equipped with suitable seals to prevent moisture from entering the bearings through the shaft opening.

Integral horsepower motors shall be equipped with bearings regreaseable in service.

8.7.9 Painting

Motors shall be painted in accordance with manufacturer's standard.

8.7.10 Nameplates

Motor nameplates and data plate material shall be stainless steel, monel, brass or bronze. Plates shall be attached by fasteners made of the same material as that of the plate.

8.7.11 Miscellaneous

All motors weighing more than 100 lbs shall be provided with the necessary number of lifting eyebolts, rings or lugs capable of supporting the weight of the motor.

8.7.12 Tests and Documentation

Motors shall be tested as specified in accordance with the standards listed.

Vendor shall furnish certified dimension drawings.

Vendor shall furnish two copies of attached Data Sheet, completed with all pertinent data, for each motor with quotation.

REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION	REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION

DESIGN DATA AND ACCESSORY EQUIPMENT

NO. OF IDENTICAL UNITS _____ SERVICE _____

NAMEPLATE: _____ kW _____ V _____ PHASE _____ Hz _____ SERVICE FACTOR

_____ r/min (SYN) _____ DUTY _____ LOCKED - ROTOR kVA

INSULATION CLASS: A ☐, B ☐, F ☐, H ☐, SEALED ☐, ENCAPSULATED ☐ AMBIENT TEMPERATURE: 40 °C ☐, _____°C ☐

TORQUE DESIGN: B ☐, N ☐, _____ ☐

AREA CLASSIFICATION: CLASS I ☐, II ☐, III ☐, GROUP A ☐, B ☐, C ☐, D ☐, E ☐, F ☐, G ☐, DIVISION 1 ☐, 2 ☐

T - RATING _____°C UNCLASSIFIED ☐

LOCATION: INDOOR ☐ OUTDOOR ☐ DUSTY ☐ ALTITUDE _____

ATMOSPHERIC MIXTURE _____

ENCLOSURE: WEATHER - PROTECTED TYPE (I) ☐, (II) ☐ TOTALLY ENCLOSED FAN - COOLED ☐

TOTALLY ENCLOSED NONVENTILATED ☐ EXPLOSIONPROOF ☐ _____ ☐

BEARING TYPE: BALL ☐ SLEEVE ☐ LUBRICATION: OIL ☐, GREASE ☐, FORCED - FEED ☐

SPECIFICATION: SEMAC STANDARD MI - 8 ☐ API RP 541 ☐

_____

SOUND PRESSURE LEVEL REQUIREMENTS _____

STARTING: FULL VOLTAGE ☐, REDUCED VOLTAGE ☐, _____ % OF VOLTAGE UNLOADED ☐, LOADED ☐

MOUNTING METHOD: HORIZONTAL ☐, VERTICAL ☐, _____ ☐

STAINLESS STEEL NAMEPLATE ☐ FILTER FOR WP (I) ☐, (II) ☐

DRAIN PLUGS ☐, BREATHER DRAIN ☐

TEMPERATURE DETECTORS: RESISTANCE ☐, THERMISTOR ☐, WINDINGS ☐, BEARINGS ☐

VIBRATION SENSOR: DRILLED AND TAPPED HOLE FOR ☐, NON - CONTACT PROBE ☐, VELOCITY TRANSDUCER ☐

SPACE HEATERS ☐ _____ W _____ V _____ PHASE

DIFFERENTIAL PROTECTION ☐ SURGE PROTECTION ☐ OVERSIZED TERMINAL BOX ☐

MANUFACTURERS DATA

MOTOR MFR _____ TYPE _____ STYLE NO. _____

FULL LOAD, r/min _____ WEIGHT _____ FRAME NO. _____

BEARING MFR _____ BEARING NO. _____

STARTING TORQUE _____ % LOCKED ROTOR TORQUE _____ %

LOCKED ROTOR AMPERAGE _____ A

PULL UP TORQUE _____ %

FULL LOAD TORQUE _____ Nm

BREAKDOWN TORQUE _____ %

ACCELERATING TIME IN SECONDS (0-FULL SPEED _____

TESTS (WHEN SPECIFIED) _____

STALL TIME AT ZERO r/min _____ SECONDS

NUMBER OF CONSECUTIVE STARTS _____

LOAD	FULL	3/4	1/2
AMPERES			
EFFICIENCY, %			
POWER FACTOR			
SPEED, r/min			

SAFE TIME-CURRENT CURVE ☐

SPEED - TORQUE CURVE ☐

NOTES: _____

DATA SHEET	INDUCTION MOTOR TAG NO.	SHEET OF	JOB NUMBER
		DOCUMENT NUMBER	REV

D.S.S MOBILE PLANT

MOTOR LIST & UTILIZATION

Item	HP	No Off	Process Options 1	2	3	4	5	6	7	8	Module Location	Volts
Pump No. 1	1½	1	✓	✓	✓	✓	x	✓	✓	✓	Permanent	240
Pump No. 2	1½	1	✓	✓	x	✓	✓	✓	✓	x	Permanent	240
Pump No. 3	1½	1	x	x	x	✓	✓	✓	✓	x	Permanent	240
Pump No. 4	1½	1	x	x	x	✓	✓	✓	✓	x	Permanent	240
Pump No. 5	7½	1	✓	✓	✓	✓	✓	✓	✓	✓	Permanent	240
Pump No. 6	1½	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	240
Pump No. 7	1½	1	✓	✓	x	✓	✓	✓	✓	x	Permanent	240
Dewatering Screen	2	1	✓	✓	✓	✓	✓	✓	✓	✓	Permanent	480
Sizing Screen	1	1	✓	✓	x	✓	✓	✓	✓	x	Permanent	480
Desliming Screen	0.6kw	2	x	x	x	✓	✓	✓	✓	x	Permanent	480
Conditioner No. 1	1/3	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	115/1
Conditioner No. 2	1/4	1	✓	✓	x	✓	✓	✓	✓	x	Permanent	115/1
Screw Conveyor No. 1	1½	1	✓	✓	✓	✓	✓	✓	✓	✓	Permanent	480
Screw Conveyor No. 2	1½	1	x	x	x	✓	✓	✓	✓	x	Permanent	480
Froth Pump No. 1	2	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	480
Froth Pump No. 2	2	1	✓	✓	x	x	x	x	x	✓	Permanent	480
Flotation Cells Bank No. 1 (Wemco)												
Mechanisms	3	5	✓	✓	✓	✓	✓	✓	x	✓	Removable 1	480
*1Paddles	½	2	✓	✓	✓	✓	✓	✓	x	✓	Removable 1	480
Flotation Cells Bank No. 1 (Denver)												
Mechanisms	3	5	✓	✓	✓	✓	✓	✓	x	✓	Removable 2	480
Paddles	½	2	✓	✓	✓	✓	✓	✓	x	✓	Removable 2	480
Flotation Cells Bank No. 2a (Denver DR)												
Mechanisms	1½	10	✓	✓	x	x	x	x	x	x	Removable 3	480
*2Paddles	½	4	✓	✓	x	x	x	x	x	x	Removable 3	480
Flotation Cells Bank No. 2b(Denver Sub A)												
Mechanisms	1½	10	✓	✓	x	x	x	x	x	x	Removable 4	480
Paddles	½	4	✓	✓	x	x	x	x	x	x	Removable 4	480
Froth Cell Blower	1½	1	✓	✓	x	x	x	x	x	x	Removable 3	480
Reagent Pump No. 1	31W	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	115/1
Reagent Pump No. 2	31W	1	✓	✓	x	✓	✓	✓	✓	x	Permanent	115/1
Reagent Pump No. 3	31W	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	115/1
Reagent Pump No. 4	31W	1	✓	✓	x	✓	✓	✓	✓	x	Permanent	115/1
Reagent Pump No. 5	31W	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	115/1
Reagent Pump No. 6	31W	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	115/1
Reagent Pump No. 7	31W	1	✓	✓	✓	✓	✓	✓	x	✓	Permanent	115/1
Reagent Pump No. 8	31W	1	✓	✓	x	x	x	x	x	x	Permanent	115/1
Reagent Pump No. 9	31W	1	✓	✓	x	x	x	x	x	x	Permanent	115/1
Reagent Pump No. 10	31W	1	✓	✓	x	x	x	x	x	x	Permanent	115/1
Reagent Pump No. 11	31W	1	✓	✓	x	x	x	x	x	x	Permanent	115/1
Reagent Pump No. 12	31W	1	✓	✓	x	x	x	x	x	x	Permanent	115/1
Reagent Pump No. 13	31W	1	✓	✓	x	x	x	x	x	x	Permanent	115/1

*1 Existing

NOTES: - Froth Cell Installation Options; one of following at any one time.

i) Removable 1 + Removable 2 - Drives (5 x 3) + (5 x 3)
ii) Removable 1 + Removable 3 - Drives (5 x 3) + (10 x 1½)
iii) Removable 1 + Removable 4 - Drives (5 x 3) + (10 x 1½)
iv) Removable 2 + Removable 3 - Drives (5 x 3) + (10 x 1½)
v) Removable 2 + Removable 4 - Drives (5 x 3) + (10 x 1½)

8.8 Electrical Drawings

Drawing No.	42022-E-01	Single Line Diagram
	42022-E-02	Panel Layouts and Wiring Diagrams
	42022-E-03	Elementary Diagrams
	42022-E-04	Control Block Diagram
	42022-E-05	Electrical Equipment and Grounding Layout
	42022-E-06	Power and Lighting Layout

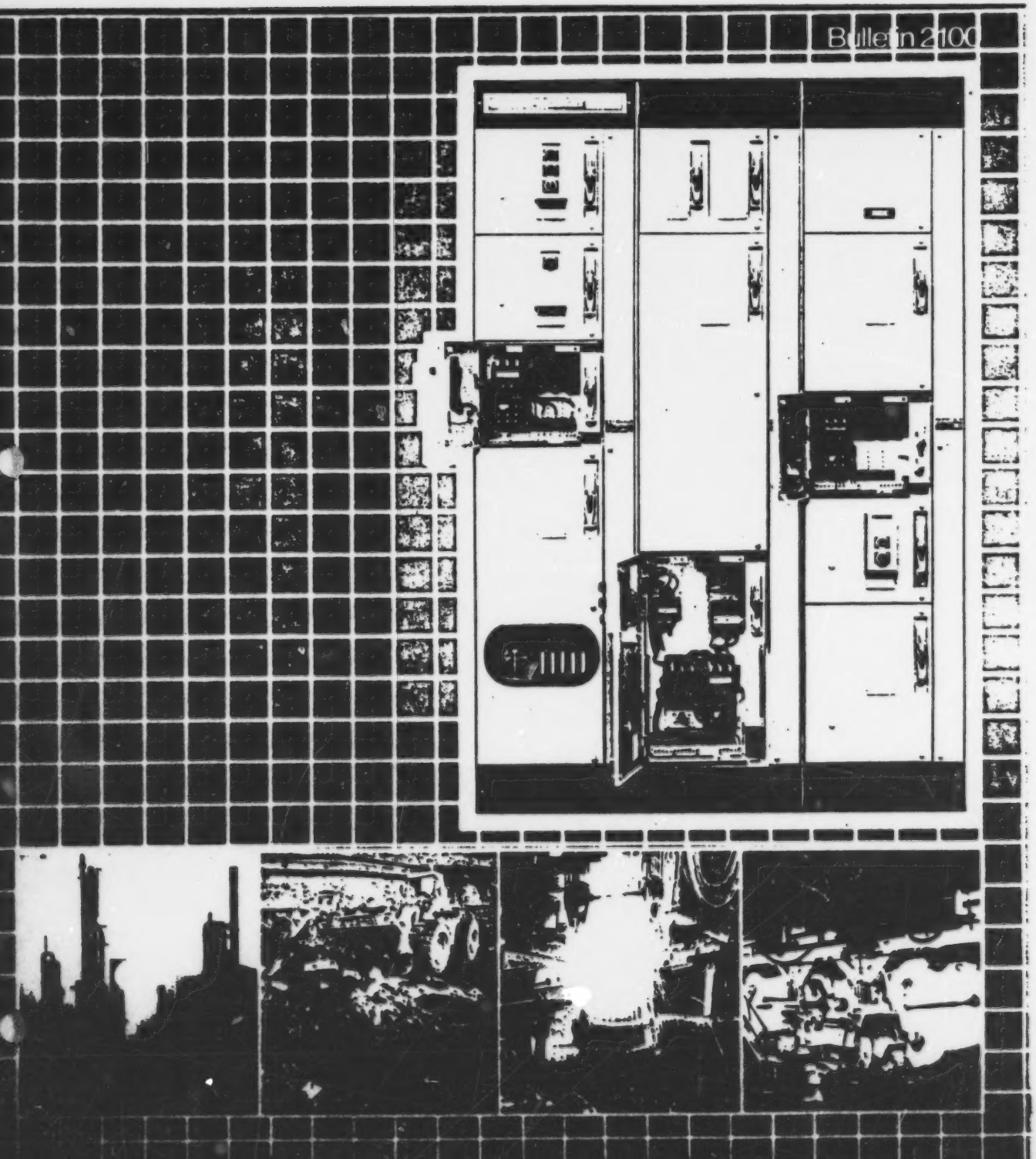
8.9 Manufacturers' Information

Contained herein are copies of the manufacturers' data sheets for the items of electrical equipment included in our design.

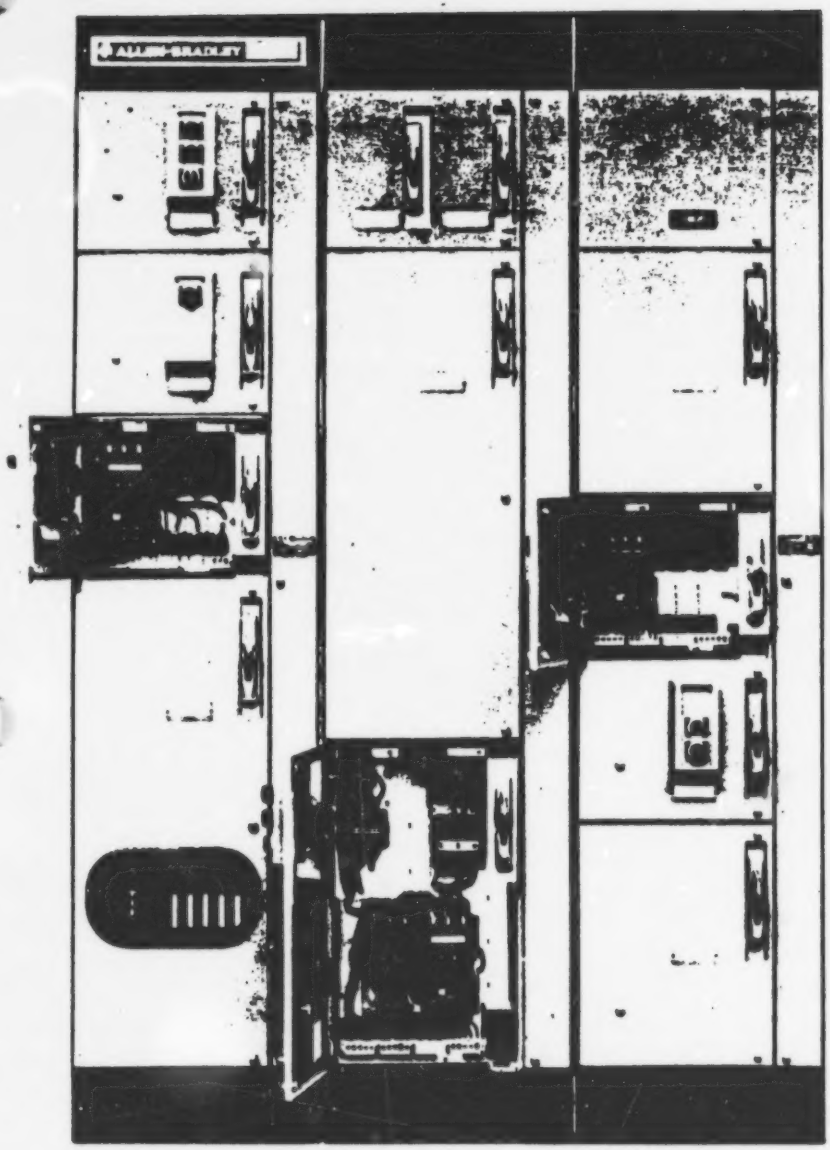
Allen-Bradley

Centerline Motor Control Center

Bulletin 2100



The Allen-Bradley Bulletin 2100 Centerline® Motor Control Center offers convenience, safety and reliability.



Years of accumulated experience combined with proven quality is Allen-Bradley's Centerline Motor Control Center. It is designed to meet the needs of users to provide them with the most wanted features they have asked for. After a decade it is still recognized as the best design and highest quality motor control center in the market. Centerline Control Centers meet or exceed the latest published standards of EEMAC requirements for motor control centers.

Centerline Motor Control Centers consists of one or more vertical sections which contain control devices that are prewired and tested within a modular plug-in unit. A maximum of four vertical sections front mounted, or 8 vertical sections back-to-back construction are shipped in one assembly.

The main horizontal bus is located in the center of the section. This centralized location provides better heat distribution and makes the main bus accessible from floor level permitting easier and safer bus splicing and maintenance. The center-fed 300 Amp rated vertical bus supplies power to the individual units above and below the horizontal bus for effective 600 Amp capacity providing virtually unrestricted unit arrangement. A glass polyester material (Rosite®) provides isolation and bracing. This material sandwiches the bus bars creating a "dead" front.

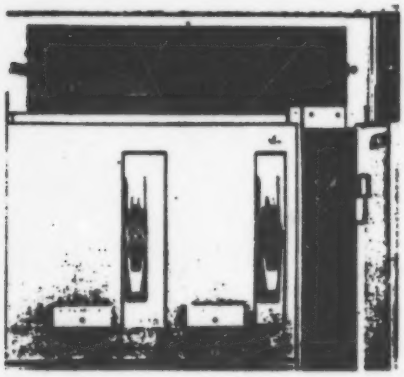
Bulletin 2100 Centerline® Vertical Section Design

The Centerline Motor Control Center is designed to provide exceptional reliability, ease of installation and simplified maintenance. These free standing front mounting vertical sections are 2286mm (90") high, 508mm (20") wide and either 381mm (15") or 508mm (20") deep. A selection of special widths, and back-to-back construction are also available. The unique back-to-back construction is essentially two complete motor control centers bolted together with completely separate horizontal and vertical bus systems providing full capacity and same phase sequence on front and rear sections. Vertical sections are available in EEMAC Type 1 construction with or without gasketing provisions for unit doors, with or without bottom plates. EEMAC Type 12 with gasketing provisions for unit doors, bottom plates and cover plates and, NEMA Type 3R non-walk-in construction. Walk-in, and walk-thru enclosures are available.

Features of Bulletin 2100 Vertical Sections:

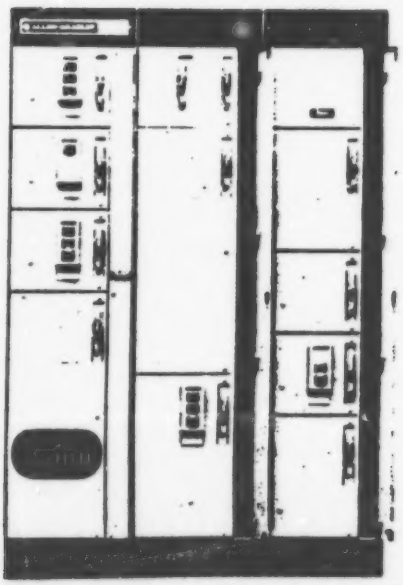
Horizontal Wireway

- Located at the top and bottom of section, each measures 152mm (6") high. They are the full depth of each vertical section since the horizontal power bus is mounted in the center out of the way.
- Isolated from the power bus compartment by steel barriers.
- Each wireway provides a minimum of 2286mm² (90 square inches) of unobstructed front access for greater convenience and safety.
- Wireway covers have captive screws avoiding the nuisance of loss when covers are removed during installation or maintenance.



Vertical Wireway

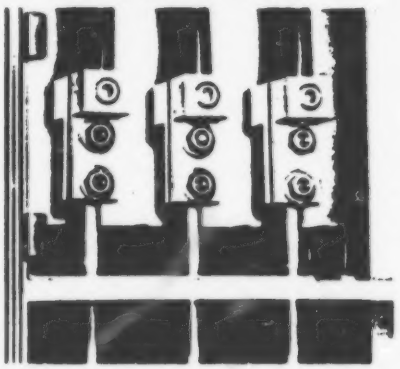
- Measures 111mm (4.37") wide by 178mm (7") deep, runs the full height of the plug-in unit space in each vertical section, it remains intact even when the units are withdrawn.
- Located on the right side of each section and isolated from the power bus.
- Size 1 and 2 units have one access opening to the vertical wireway for greater isolation between units and wireways. Larger units have (2) to accommodate their larger requirements.
- Removable sealing straps top and bottom allows "laying in" of cables—no need to thread wire bundles through the wireway.
- The door secures with three ¼ turn pawl latches.
- The door can be easily removed to provide maximum wiring convenience.



Incoming Line Provisions

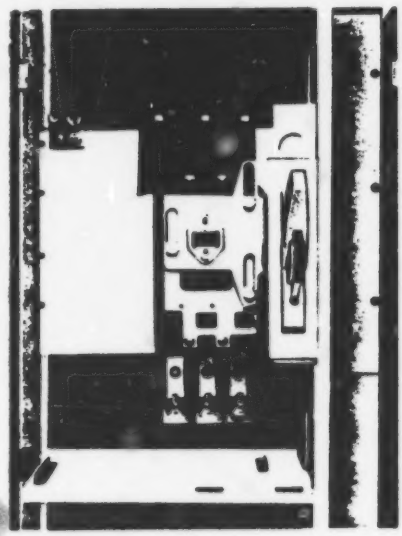
Main Lug Compartments

- Available for top or bottom entry, rated at 600, 800, 1000, 1200, 1600 or 2000 Amps.
- Optional protective barriers are available to reduce the hazard of accidental contact with incoming lugs whenever the compartment door is open.



Main Circuit Breaker

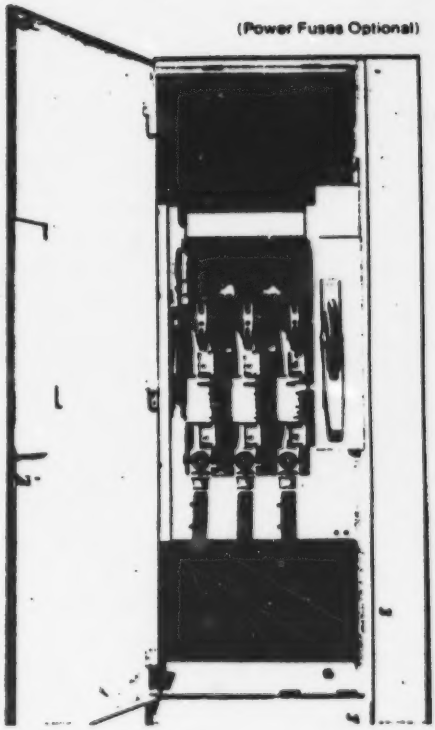
- Available for top or bottom entry, rated at 100, 225, 400, 600, 800, 1000, 1200, 1600, or 2000 Amps.
- Mains rated 400 to 1200 Amps for bottom entry are supplied reverse feed thereby providing the convenience of straight through wiring.
- Circuit breakers are front accessible and are supplied with removable protective barrier to reduce the hazard of accidental contact with line terminals.



Main Fusible Disconnect

- Available for top or bottom entry, rated at 30, 60, 100, 200, 400, 600, 800, or 1200 Amps, supplied with either Type C, K, H, J or R fuse blocks through 600 Amps, and L fuse blocks above 600 Amps.
- Mains rated through 400 Amps are supplied with Allen-Bradley Bulletin 1494 heavy duty rated fusible disconnect.
- Mains rated 600 Amps and above incorporate a molded case switch with separate fuse blocks.
- Fusible disconnect type mains are front accessible and are supplied with removable protective barrier to reduce the hazard of accidental contact with terminals.
- Mains rated 600A through 1200A are reverse fed for bottom entry, providing the convenience of straight through wiring.

(Power Fuses Optional)



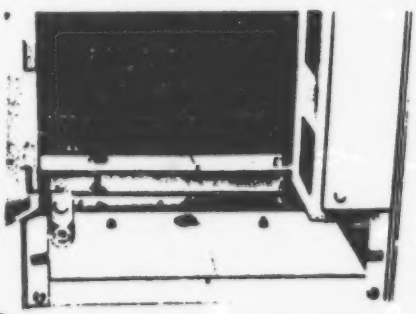
Grounding Provisions

Horizontal Ground Bus

- Unplated copper 6.4mm (¼") x 25.4mm (1") is supplied as standard. 6.4mm (¼") x 50.8mm (2") is available as an option.
- Located in top or bottom horizontal wireway of the vertical section.

Ground Lug

- Mechanical copper multiple connection bar is supplied in each section for ten #14-6 wires.



- Mechanical copper ground lug is provided as standard in incoming line sections and if necessary at the opposite end of the assembly.
- Lug for one #4-500 MCM cable

Unit Load Ground Connector

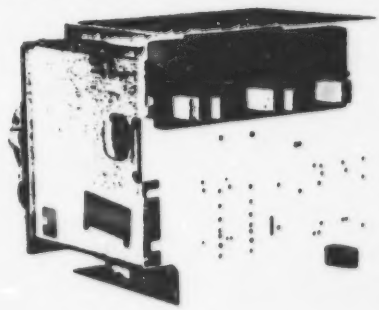
(Optional)

- Assembly consists of unplated copper load ground bus and unit load ground bus connector.
- Termination point of load ground cable is in the vertical wireway at each unit. This is especially handy when multiconductor cable is used. It eliminates the need to strip back ground wire to horizontal ground bus.
- The fixed connection does not have to be removed when the unit is withdrawn, leaving the motor ground intact.

Plug-In Vertical Ground Bus Stab

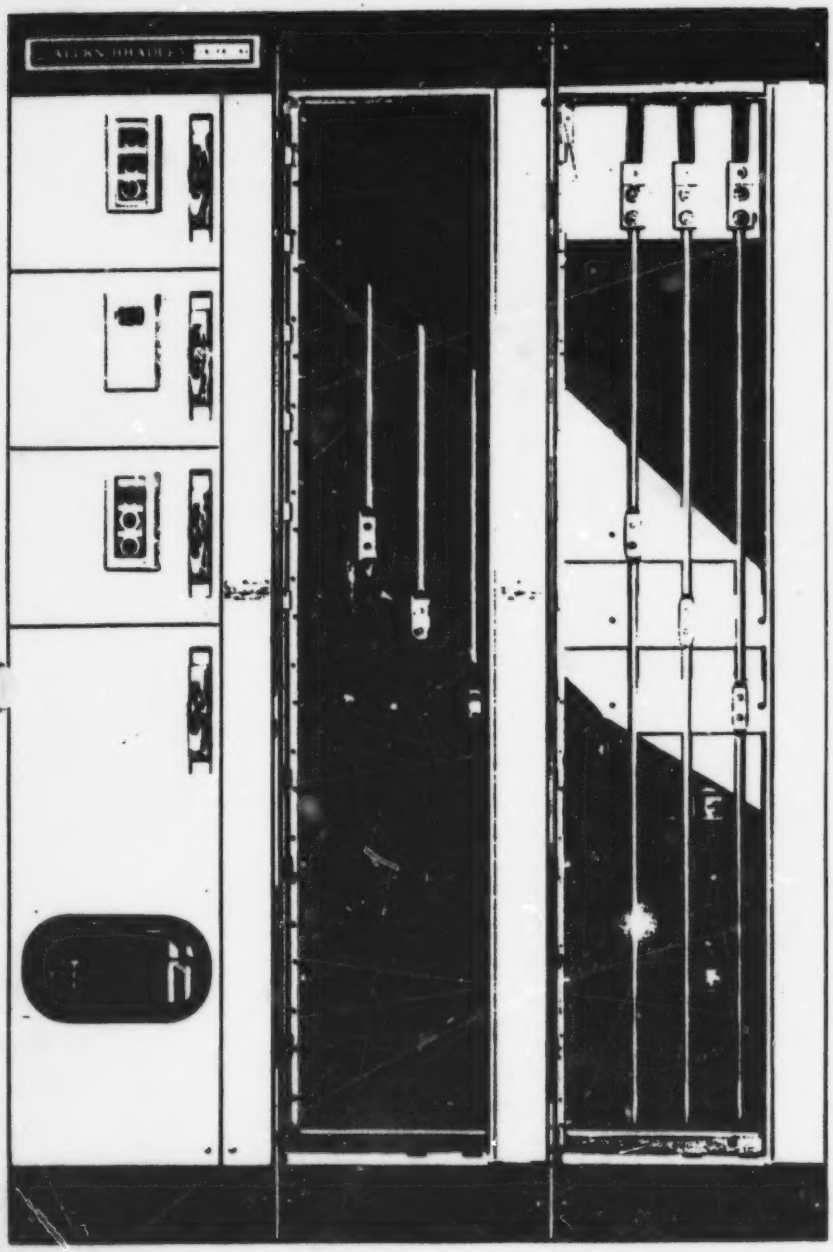
(Optional)

- Stab is unplated copper, located on the left rear side of the unit.
- The ground stab engages before the unit power stabs engage the vertical power bus and disengages after the power stabs have been disengaged from the vertical bus.



Bus Bracing

Both the horizontal and vertical bus are SUPPORTED, BRACED and ISOLATED by one piece continuous Rosite molding. Rosite is a high strength, track resistant, glass-filled polyester material that provides exceptional insulating properties, as well as phase-to-phase isolation on vertical bus, isolation of vertical bus from horizontal bus, and short circuit withstandability. The standard bus is braced for 42,000 RMS symmetrical Amps. Optional bracing is available for 65,000 or 100,000 RMS symmetrical Amps.



Horizontal Bus

- Runs through the center of each vertical section.
- Edge mounted on 165mm (6½") centers in a vertical plane, in the recessed channels of the Rosite support molding. This minimizes dust collecting surfaces that could cause a short circuit.
- Tin plated aluminum bus is standard.
- Tin plated copper bus is optional.
- The centralized location of the bus distributes heat more evenly and makes the main bus accessible from floor level for easy installation of splices and maintenance.

Vertical Bus

- Center-fed, with the capacity of 300 Amps above and below the main bus for an effective loading of 600 Amps, thereby permitting virtually unrestricted unit arrangement. An optional 600 Amp vertical bus is available, providing 1200 Amps of plug-in loading capabilities in a single section.
- Continuously braced and supported by one piece Rosite molding.
- Tin plated copper bus is standard.
- Vertical bus cover is a one piece Rosite molding which provides "dead" front construction. The red color is used to indicate the close proximity of potentially energized bus bar.
- This Rosite cover also provides effective isolation of the vertical bus from the plug-in unit. This cover, along with the support piece of Rosite, provides an enclosed vertical bus with phase-to-phase isolation. This makes a phase-to-phase or ground fault on the vertical bus system virtually impossible.
- Isolation of unused plug-in openings can be accomplished by plugging in protective caps molded of semi-rigid, non-flame support material.

Removable Top Plate

- Top plates of each vertical section are removable for convenience of cutting conduit holes.

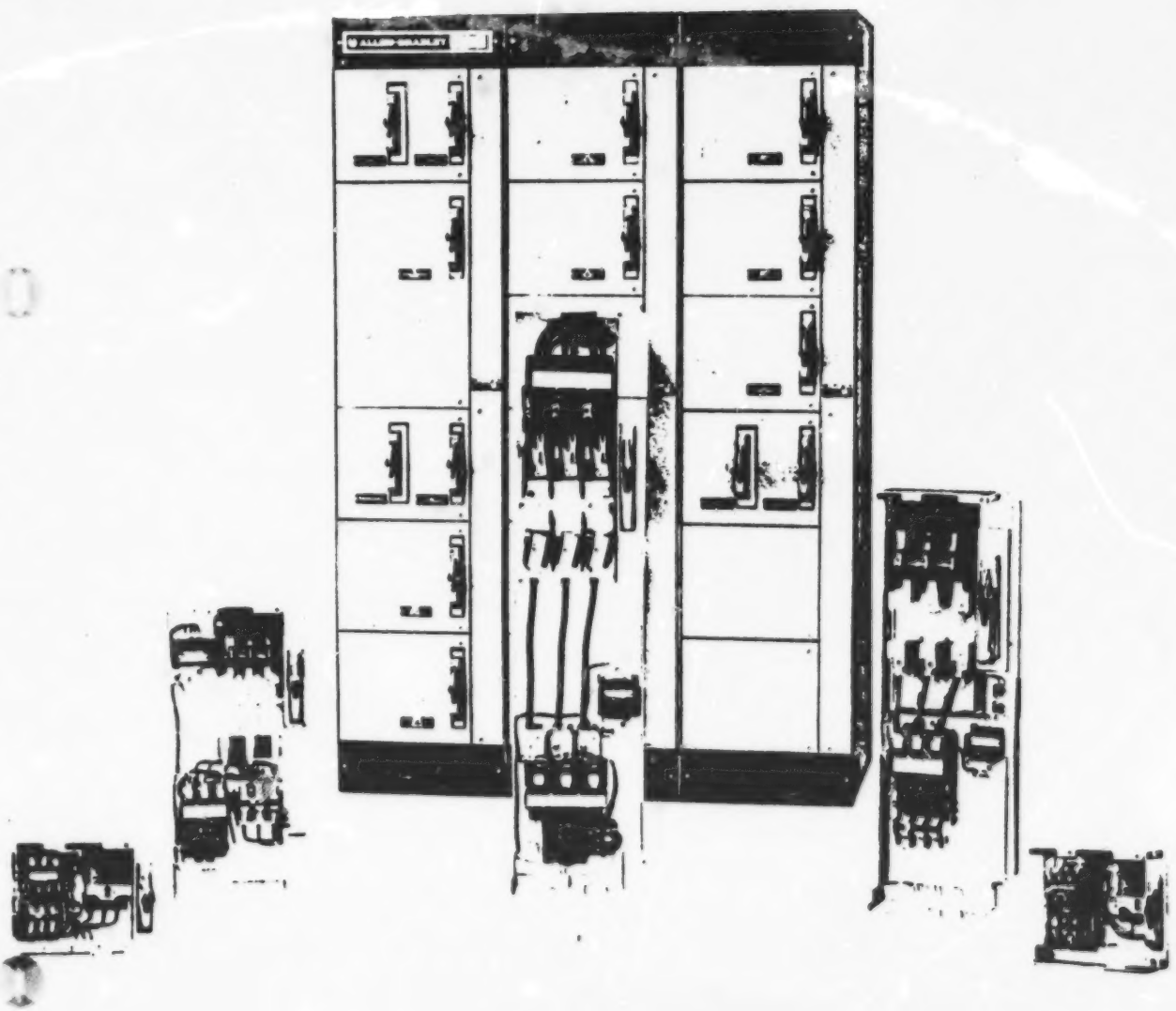
Finish

The standard exterior finish is ANSI No. 49 medium light gray with a contrasting charcoal gray trim.

- All unpainted metal parts are plated for corrosion resistance.

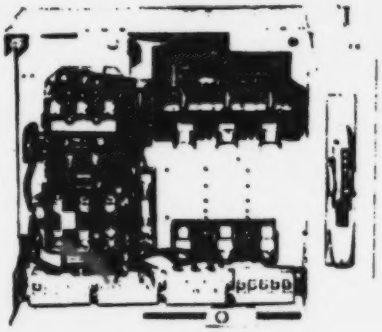
Centerline® Plug-In Starter Units

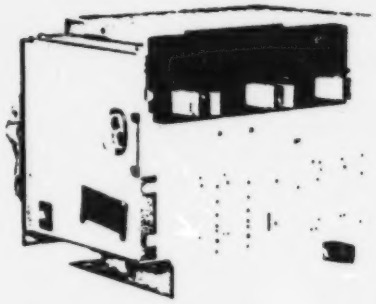
Centerline's modular unit design effectively isolates the unit from wireways and adjacent units, protects the electrician against contact with live parts, makes for convenient device access, easy handling and fast installation.



Combination Starter Devices

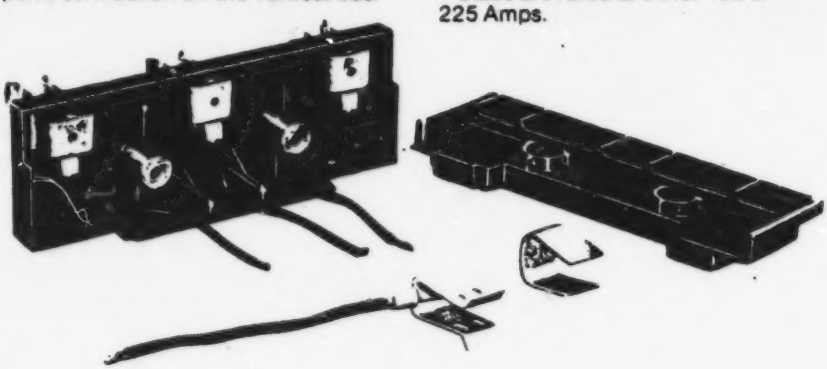
- Bulletin 509 electromagnetic vertical lift design starter with double break cadmium oxide silver contacts.
- Power contacts may be changed without removing the power wiring for quicker maintenance.
- Up to 7 auxiliary contacts in addition to the hold-in contact can be easily installed on full voltage non-reversing combination starters to provide extra circuit capability.
- All starters are equipped with Bulletin 592 eutectic alloy type overload relays which provide accurate and dependable motor protection.
- Plug-in construction for full voltage non-reversing up to Size 5, reversing and multi-speed units up to Size 4.
- Unit short circuit and overcurrent protection is provided by either a Heavy Duty Bulletin 1494 fusible disconnect, or Westinghouse MCP's or thermal-magnetic circuit breakers.
- On fusible units power fuse clips are mounted up front for easy access.
- Up to 2 auxiliary contacts can also be installed on either the disconnect switch or circuit breaker operating mechanism.
- Each vertical section has the capability of having up to six Size 1 or 2 full voltage non-reversing starters per section.





Plug-In Stab Assembly

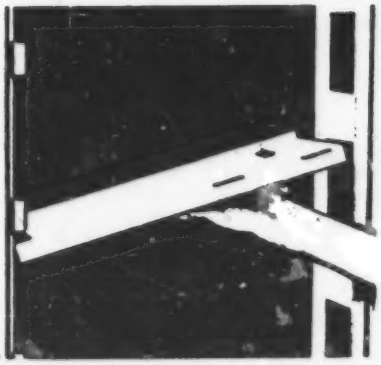
- Made up of a two piece Rosite molding.
- Interlocks with the vertical bus molding to provide effective isolation.
- Rosite molding provides support and phase-to-phase isolation for 3 prewired stabs.
- Forms an effective fault barrier between the starter unit and vertical bus.
- No exposed wires outside unit.
- Separate isolated path for each phase makes it virtually impossible for a unit fault to spread to the vertical bus.
- Stabs are electrolytically tin plated copper.
- Stabs are free floating, self-aligning and designed to tighten during heavy current surges.
- Stabs are backed by a steel spring clip to provide high pressure two-point connection on the vertical bus.
- Stabs are connected to power cable with a "W" type crimp.
- Stabs are rated at either 100 or 225 Amps.



Added Features For Convenience and Greater Safety

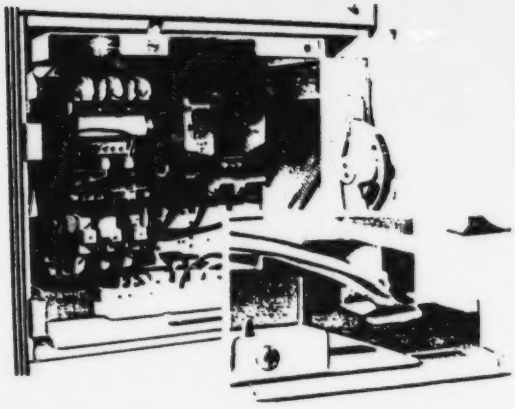
Unit Support Pan

- Supports and guides the unit in and out of the structure assuring proper alignment of the unit power stabs with the vertical bus.
- Removable from structure without the use of tools to provide easy rearrangement of units at 12 different locations within each section.
- Provides steel isolation barrier between units or unit and blank space.
- All spaces are prepared for future units.
- Grounding tab is an integral part of the support pan for establishing ground between units and the vertical structure.



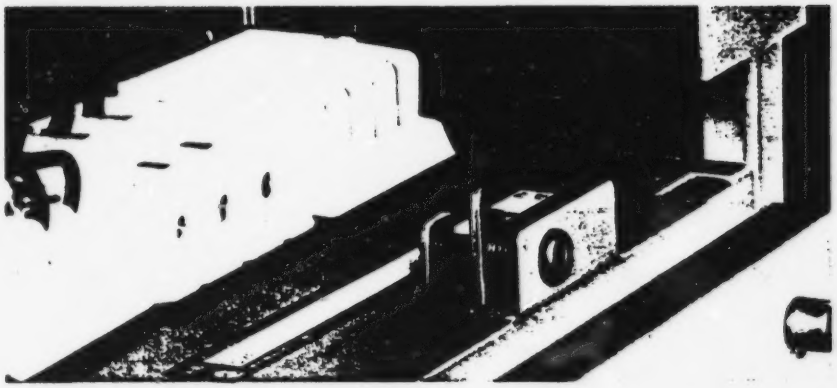
Wire Tunnel

- Eliminates the need to "stuff" power and control wiring or terminal blocks in the wireway when removing unit. It remains in the unit space.
- Unit load ground connector allows the ground wire to remain connected when unit is withdrawn if section is provided with an optional vertical unit load ground bus.



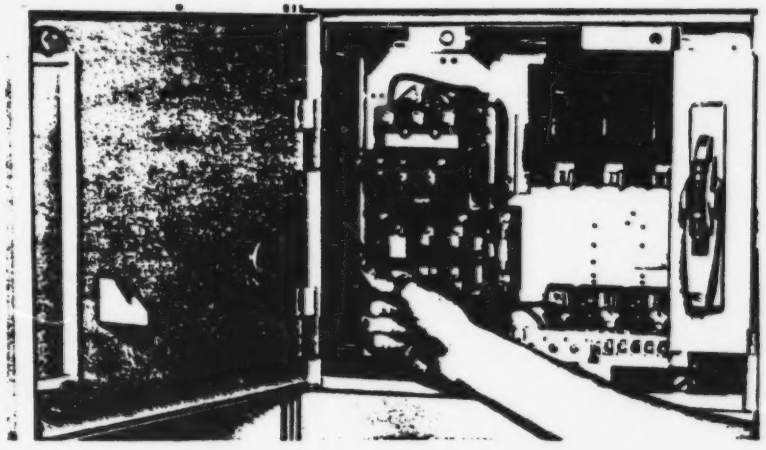
Captive Latches

- Two front mounted pawl type latches secure each unit in the section, larger units have (3) latches. These latches are mounted upfront (no need for reaching in the back of unit for securing and removal) providing convenience and improved safety when changing inserts.
- A ¼ turn engages the latch into the unit support pan. Additional turns required to tighten into place.



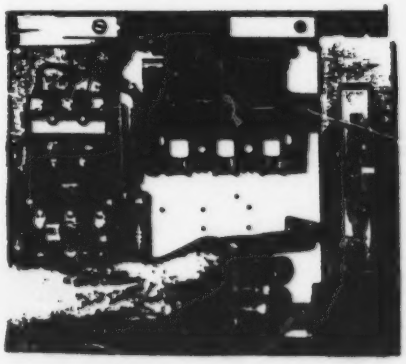
Unit Door

- The removal of the unit door is simply done by removing the hinge pins, returning the door to the nearly closed position then lifting it off. This unique hinge arrangement reduces the possibility of doors falling on legs and feet.
- Door is held closed by ¼ turn latches providing convenience and quick access.



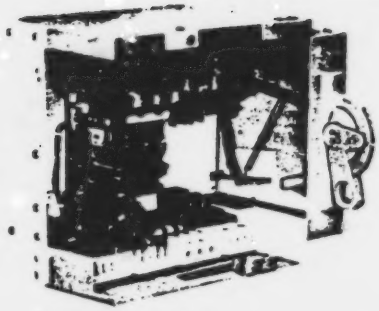
Disconnect Handle

- All units are supplied with an extremely rugged flange mounted operating handle that provides direct control of the disconnecting means.
- A safety interlock is designed to guard against the unit door from being opened while the disconnecting means is closed.
- A defeater device is provided to permit opening the door for inspection of a unit by authorized personnel without interrupting the power circuit.
- The handle can be locked in the OFF position with up to 3 padlocks for maintenance or to protect against operation by unauthorized personnel.
- A field drill-out feature is also provided to permit locking in the ON position with one padlock.



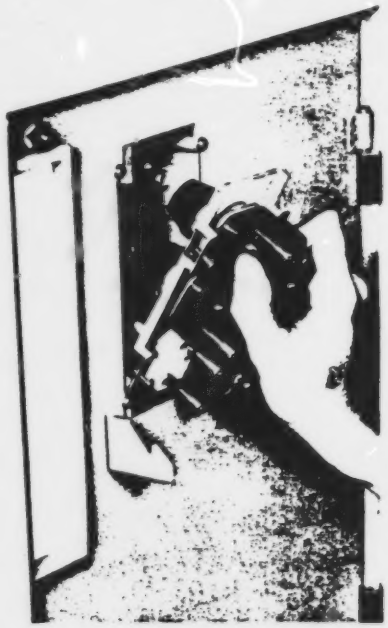
Pull-Apart Terminal Blocks

- Supplied as standard with all EEMAC Type B units for control wiring and for power terminals on Size 1 and 2 starters. Size 3 starters use fixed load terminal blocks. Power Terminal Blocks 3 pole are rated at 60 Amps for 600 volts, 90° C and Control Terminal Blocks 5 pole, are rated at 25 Amps for 600 volts.
- Mounted up front within the unit, not in the vertical wireway. This provides for added safety and more room in the vertical wireway for cabling.
- Up to 3 control blocks or 15 terminals with power block can be mounted in each starter. If the power block is deleted up to 4 control blocks or 20 terminals can be provided.



Control Stations

- Starter units can be supplied with push buttons, selector switches or pilot lights in a door mounted control station.
- Recessed mounting of the contact blocks in the die cast housing helps to minimize the hazard of accidental contact with live parts when unit door is open.
- Removal of the pilot device mounting plate is done by loosening 4 captive screws from the control station. No need to disconnect wiring when unplugging and removing units.



Unit Isolating Covers

- Further isolation of vertical wireways from units can be accomplished by a unit isolating barrier molded of a semi-rigid material that snaps into access opening in the vertical wireway.

Delivery Programs

SC—This program offers standard, stock supported, individual plug-in units as well as vertical sections in which plug-in units are to be field installed.

These units can be assembled at the factory at a lengthened delivery time.

Engineered—The engineered program offers a broad line of assembled motor control equipment with a wide range of special controls and bus options to meet MOST motor control applications.

For a complete listing of available items and ordering information contact your nearest Allen-Bradley Sales Office.

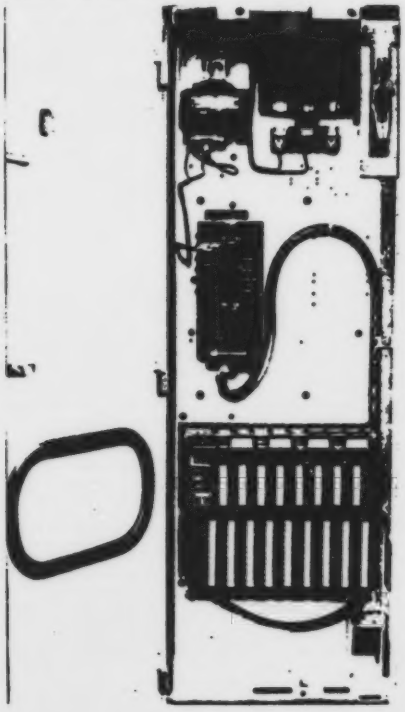
New Centerline Packages

A Centerline® Package That Reduces Costs

Now Allen-Bradley lets you reduce in-plant wiring and hardware costs by integrating Bulletin 1771 programmable controller Input/Output modules with Bulletin 2100 Centerline Motor Control in a single package. With this package, starter wiring can be standardized and simplified, timing and logic functions are handled by the PC. Hardware is simplified too, shielded communication cables replace most of the massive bundles of wire between MCC and control consoles. Start-up and trouble shooting time is drastically reduced through PC's diagnostics capabilities, and reprogramming can replace rewiring as process sequences change. (Refer to Publication SD402 for more information including calculations of the approximate cost savings).

Unique Assets of Bulletin 1771 and Bulletin 2100:

- Small size allows the I/O rack to be packaged in a plug-in unit enabling each shipping block to contain an integral I/O rack.
- Plug-in units are available with 32 or 64 I/O size racks.
- No more large bundles of wires across shipping blocks. Communication cables handle most connections between I/O racks. On-site wiring is simplified and faster. On engineered motor control centers Allen-Bradley can interwire the starters to the I/O rack. The entire MCC and I/O rack is then tested as a complete package.
- A viewing window in every I/O rack unit door allows for inspection of I/O status indicators. It lets you monitor and troubleshoot unit during start-ups. (For more detailed information on the PC/MCC combination refer to Publication 2100-2.2).



Bulletin 1330 AC Drive Combined With Bulletin 2100 Motor Control Center Creates A New Package

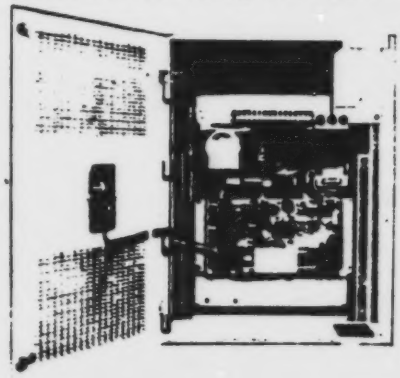
The Allen-Bradley Drives Division offers versatile Bulletin 1330 1-5 HP adjustable frequency motor drives to provide variable speed operation of 3 phase induction motors.

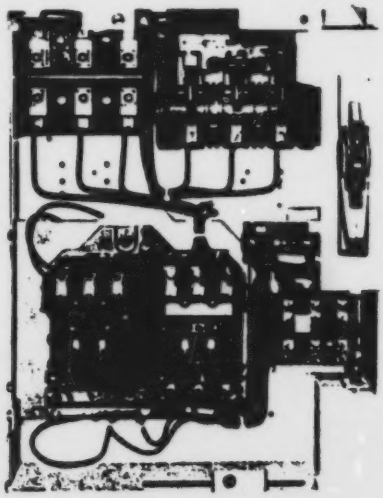
New advanced LSI (Large Scale Integration) circuitry on a ¼" square chip provides 6300 transistors to perform all logic and control functions. This means simplified drive construction, reducing unit size and cost and improving reliability. In addition, high input power factor and efficiency combine to significantly reduce electric power consumption when compared to other types of variable frequency drives.

Momentary overload capacity and built-in protection circuits prevent against operation under severe motor overload (above 150%) or short circuit conditions. Output is PWM (Pulse Width Modulation) for smooth predictable motor performance with minimum pulsing (cogging) that could adversely affect product quality.

Easily installed into the Allen-Bradley 2100 Motor Control Center, the Bulletin 1330 offers these additional optional capabilities:

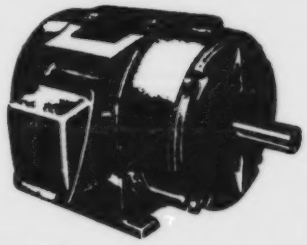
- By-pass contactor allows the drive to be by-passed, for across-the-line starting.
- New BCD module interfaces to a programmable controller to provide BCD logic control of motor speed and forward or reverse rotation.
- Analog interface capability also available for controlling motor speed.



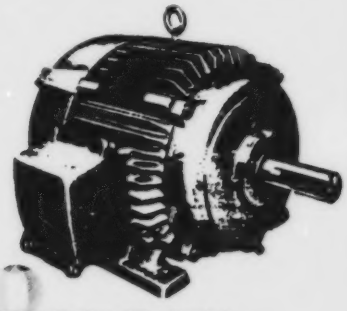


AC MOTORS
Integral Hp Squirrel Cage, Life-Line T

Standard Motors, Squirrel Cage Induction, 3 Phase, 60 Hz, 40°C Ambient, EEMAC design B or A, class B insulated
Type HSB, 3 Phase, 60 Cycles 200, 230, 460, 575 Volts



Drip-proof



Totally Enclosed Fan Cooled

Hp	Rpm	Drip-proof Class B Insulated, S.F. 1.15 Frame	List Price	Totally Enclosed, Fan Cooled Class F Insulated, S.F. 1.15 Frame	List Price	Totally Enclosed, Explosion-Proof, Class B Insulated, Classes I Gr D, II Gr F & G S.F. 1.0 List Price	Approx. 575V FL Amps.
3/4	1200			143T		$ 680	1.1
1	1800	143T	$ 256	143T	$ 322	684	1.3
	1200			145T	412	700	1.4
1-1/2	3600			143T		716	1.8
	1800	145T	286	145T	326	690	1.8
	1200	182T	410	182T	416	706	2.1
2	3600			145T	396		2.1
	1800	145T	312	145T	352	712	2.5
	1200	184T	430	184T	432	806	2.7
3	3600	145T	414	182T	448	848	3.3
	1800	182T	330	182T	386	734	4.2
	1200	213T	542	213T	524	982	4.0
5	3600	182T	504	184T	508	870	5.2
	1800	184T	430	184T	490	924	5.6
	1200	215T	654	215T	684	1200	6.2
7-1/2	3600	184T	658	213T	708	1020	7.7
	1800	213T	530	213T	612	1084	8.3
	1200	254T	912	254T	984	1522	8.6
10	3600	213T	682	215T	764	1284	10.0
	1800	215T	636	215T	736	1288	10.7
	1200	256T	1018	256T	1214	1836	10.5
15	3600	215T	778	254T	1094	1770	14.5
	1800	254T	812	254T	1162	1730	15.7
	1200	284T	1290	284T	1800	2798	16.0
20	3600	254T	1028	256T	1388	2082	19.7
	1800	256T	902	256T	1396	2014	20.4
	1200	286T	1520	286T	2046	2992	20.4
25	3600	256T	1220	284TS	2026	2730	24.0
	1800	284T	1158	284T	1728	2840	25.6
	1200	324T	1868	324T	2920	4024	24.4
30	3600	284TS	1536	286TS	2304	3240	29.2
	1800	286T	1318	286T	1980	3060	29.9
	1200	326T	2072	326T	3388	4482	28.6
40	3600	286TS	1956	324TS	3216	4212	37.8
	1800	324T	1734	324T	3040	4412	39.6
	1200	364T	2584	364T	4682	6732	37.9
50	3600	324TS	2338	326TS	4070	5284	46.4
	1800	326T	2090	326T	3725	4880	47.8
	1200	365T	3276	365T	5342	6324	46.7
60	3600	326TS	2758	364TS	5420	6194	56.3
	1800	364T	2516	364T	4916	6116	57.8
	1200	404T	4178	404T	6804	7958	58.4
75	3600	364TS	3844	365TS	6852	8330	68.0
	1800	365T	3080	365T	6298	7814	71.0
	1200	405T	5124	405T	7826	9812	68.2
100	3600	365TS	4738	405TS	8962	10368	88.6
	1800	404T	3960	405T	7982	9682	93.00
	1200	444T	7140	444T	10918	12888	92.0
125	3600	404TS	6288	444TS	11086	13104	118.0
	1800	405T	4828	444T	10816	12488	114.0
	1200	445T	8130	445T	13200	16180	116.0
150	3600	405TS	7548	445TS	13534	16730	136.0
	1800	444T	5838	445T	12078	14024	136.0
	1200	445T	9618	447T	15488	17800	138.0
200	3600	444TS	9182	447TS	19648	21422	183.0
	1800	445T	7818	447T	18888	18172	177.0
	1200	506E	14300	449T	22300	25840	184.0

Note: Motor Prices Subject to A-15 Discount

1. EEMAC design A
2. For 460 volts mult. by 1.25; for 230 volts by 2.50; for 200 volts by 2.9.
3. These ratings are single voltage only — either 460 or 575 volt. For 230V or 230/460V on these ratings — add 5%.
4. Fan cooled 143T and 145T frames are class B insulated S.F. 1.0. Explosion proof 143T and 145T frames are cast iron.
   For detail dimensions on 140 frames contact company.
5. For a standard voltage less than 416V on these 3 ratings — add 5%.
6. Fan Cooled and Explosion Proof 180T and 210T frames are made with feet drilled for both 182, 184 mounting and 213-215 mounting respectively.
7. All 3600 RPM 447TS Frame Motors are Double Hood and blower Construction

Note: Prices on this page apply only to absolutely standard motors the ratings listed. The only modifications which can be made are:

EEMAC F-2 assembly — no charge.

208 volts to 100 Hp and 416 volts to 200 Hp — no charge.

Do not use 230 volt motors on 208 volt circuits . . . check stock for 200 volt motors.

or TS shaft extension available without price addition. T extension ot available at 3800 Rpm.

or lower speed motors and their mods. refer to PL 2520 pages 5-7.

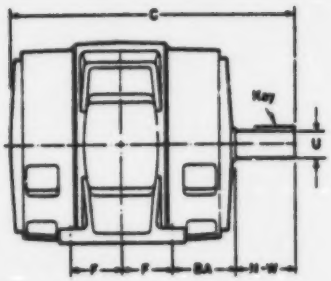
AC MOTORS
Integral Hp Squirrel Cage, Life-Line T

April, 1983

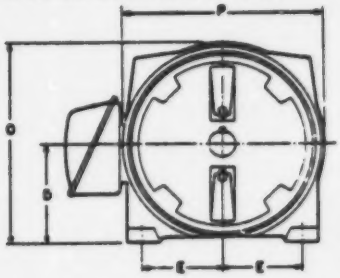
Dimensions and Weights
Drip-proof and Totally Enclosed

All dimensions are approximate, not to be used for construction purposes. Outline detail shows Life-Line T motor typical of cast iron frames 284T-445T dripproof. Specific motors will differ in detail, as this outline is a block diagram for dimensional purposes only.

Note: For detailed dimensions refer to regular dimension sheets.



Squirrel Cage, Frames 143T-449T
Horizontal, Continuous, 3 Phase



Frame	Approximate Dimensions (in inches), Approximate Net Weight (in Pounds) Common to All Squirrel Cage Motors							Open Drip-proof and Enclosed Non-Ventilated Motors				Totally Enclosed Fan-Cooled Motors			
	D	E	F	BA	U	N-W	Key Size ②	C	O	P	Net Wt.	C	O	P	Net Wt
Type HSB, Steel Frame, Cast Iron End Brackets															
143T	3.50	2.75	2.000	2.250	.875	2.250	3/16 x 3/16 x 1 3/8	12.62	6.62	6.25	40	14.19	7.24	7.48	45
145T	3.50	2.75	2.500	2.250	.875	2.250	3/16 x 3/16 x 1 3/8	12.62	6.62	6.25	45	14.19	7.24	7.48	50
182T	4.50	3.75	2.250	2.750	1.125	2.750	1/4 x 1/4 x 1 3/4	14.13	8.38	7.75	55	15.75	9.34	8.90	75
184T	4.50	3.75	2.750	2.750	1.125	2.750	1/4 x 1/4 x 1 3/4	14.13	8.38	7.75	65	15.75	9.34	8.90	85
213T	5.25	4.25	2.750	3.500	1.375	3.375	5/16 x 5/16 x 2 3/8	15.76	9.77	9.06	85	—	—	—	—
215T	5.25	4.25	3.500	3.500	1.375	3.375	5/16 x 5/16 x 2 3/8	17.26	9.77	9.06	110	—	—	—	—
254T	6.25	5.00	4.125	4.250	1.625	4.000	3/8 x 3/8 x 2 3/4	20.45	11.68	10.88	175	—	—	—	—
256T	6.25	5.00	5.000	4.250	1.625	4.000	3/8 x 3/8 x 2 3/4	22.20	11.68	10.88	190	—	—	—	—
Type HSB, Cast Iron Frame and End Brackets															
143T ③	3.50	2.75	2.000	2.250	.875	2.250	3/16 x 3/16 x 1 3/8	—	—	—	—	13.50	7.50	7.84	55
145T	3.50	2.75	2.500	2.250	.875	2.250	3/16 x 3/16 x 1 3/8	—	—	—	—	13.50	7.50	7.84	60
182T ③	4.50	3.75	2.250	2.750	1.125	2.750	1/4 x 1/4 x 1 3/4	—	—	—	—	15.42	9.50	9.60	100
184T	4.50	3.75	2.750	2.750	1.125	2.750	1/4 x 1/4 x 1 3/4	—	—	—	—	15.42	9.50	9.60	100
213T ③	5.25	4.25	2.750	3.500	1.375	3.375	5/16 x 5/16 x 2 3/8	—	—	—	—	19.20	10.88	11.20	140
215T	5.25	4.25	3.500	3.500	1.375	3.375	5/16 x 5/16 x 2 3/8	—	—	—	—	19.20	10.88	11.20	175
254T ③	6.25	5.00	4.125	4.250	1.625	4.000	3/8 x 3/8 x 2 3/4	—	—	—	—	23.00	12.88	13.28	280
256T	6.25	5.00	5.000	4.250	1.625	4.000	3/8 x 3/8 x 2 3/4	—	—	—	—	24.75	12.88	13.28	320
284TS	7.00	5.50	4.750	4.750	1.625	3.250	3/8 x 3/8 x 1 3/4	21.95	14.38	14.72	300	24.38	14.38	14.72	360
284T	7.00	5.50	4.750	4.750	1.875	4.625	1/2 x 1/2 x 3 1/4	23.32	14.38	14.72	300	25.75	14.38	14.72	380
286TS	7.00	5.50	5.500	4.750	1.625	3.250	3/8 x 3/8 x 1 3/4	23.45	14.38	14.72	370	25.88	14.38	14.72	450
286T	7.00	5.50	5.500	4.750	1.875	4.625	1/2 x 1/2 x 3 1/4	24.82	14.38	14.72	370	27.25	14.38	14.72	450
324TS	8.00	6.25	5.250	5.250	1.875	3.750	1/2 x 1/2 x 2	24.59	16.38	16.76	475	27.30	16.50	17.00	550
324T	8.00	6.25	5.250	5.250	2.125	5.250	1/2 x 1/2 x 3 1/2	26.09	16.38	16.76	475	28.80	16.50	17.00	550
326TS	8.00	6.25	6.000	5.250	1.875	3.750	1/2 x 1/2 x 2	26.09	16.38	16.76	525	28.80	16.50	17.00	610
326T	8.00	6.25	6.000	5.250	2.125	5.250	1/2 x 1/2 x 3 1/2	27.59	16.38	16.76	525	30.30	16.50	17.00	610
364TS	9.00	7.00	5.625	5.875	1.875	3.750	1/2 x 1/2 x 2	26.57	18.31	18.62	630	30.49	18.56	19.12	835
364T	9.00	7.00	5.625	5.875	2.375	5.875	5/8 x 5/8 x 4 1/4	28.70	18.31	18.62	630	32.62	18.56	19.12	835
365TS	9.00	7.00	6.125	5.875	1.875	3.750	1/2 x 1/2 x 2	27.57	18.31	18.62	690	31.49	18.56	19.12	920
365T	9.00	7.00	6.125	5.875	2.375	5.875	5/8 x 5/8 x 4 1/4	29.70	18.31	18.62	690	33.62	18.56	19.12	920
404TS	10.00	8.00	6.125	6.625	2.125	4.250	1/2 x 1/2 x 2 1/2	29.60	20.56	21.12	830	33.62	20.72	21.50	1145
404T	10.00	8.00	6.125	6.625	2.875	7.250	5/8 x 5/8 x 5 1/2	32.60	20.56	21.12	830	36.62	20.72	21.50	1145
405TS	10.00	8.00	6.875	6.625	2.125	4.250	1/2 x 1/2 x 2 1/2	31.10	20.56	21.12	915	35.12	20.72	21.50	1260
405T	10.00	8.00	6.875	6.625	2.875	7.250	5/8 x 5/8 x 5 1/2	34.10	20.56	21.12	915	38.12	20.72	21.50	1260
444TS	11.00	9.00	7.250	7.500	2.375	4.750	5/8 x 5/8 x 3	34.12	22.75	23.50	1050	38.38	23.06	24.16	1650
444T	11.00	9.00	7.250	7.500	3.375	8.500	7/8 x 7/8 x 6 1/4	37.87	22.75	23.50	1050	42.12	23.06	24.16	1650
445TS	11.00	9.00	8.250	7.500	2.375	4.750	5/8 x 5/8 x 3	36.12	22.75	23.50	1250	40.38	23.06	24.16	1950
445T	11.00	9.00	8.250	7.500	3.375	8.500	7/8 x 7/8 x 6 1/4	39.87	22.75	23.50	1250	44.12	23.06	24.16	1950
447TS ④	11.00	9.00	10.000	7.500	2.375	4.750	5/8 x 5/8 x 3	—	—	—	—	43.88	23.06	24.16	2350
447T	11.00	9.00	10.000	7.500	3.375	8.500	7/8 x 7/8 x 6 1/4	—	—	—	—	47.62	23.06	24.16	2350
449TS ④	11.00	9.00	12.500	7.500	2.375	4.750	5/8 x 5/8 x 3	—	—	—	—	48.88	23.06	24.16	2510
449T	11.00	9.00	12.500	7.500	3.375	8.500	7/8 x 7/8 x 6 1/4	—	—	—	—	52.62	23.06	24.16	2510

② Key size of drive end (rear end) of motor.

③ Cast iron frame construction not available on dripproof motors frames 143T-256T inclusive.

④ All 3600 RPM 447TS and 449TS Frame TEFC Motors have Double Hood and Blower Construction. 449 Frame Motors have Conduit Box Offset 10.75 inches toward drive end of motor.

TRANSFORMERS
Resin Encapsulated

1-50 kVA, Single Phase EP 3-75 kVA, Three Phase EPT
General Purpose and Control Types 600 Volts and Below, 60 Hertz.

Application

Types EP and EPT dry type transformers are ideally suited for all applications and offer many advantages over liquid-filled and conventional dry types. They may be installed in practically any location **indoors or outdoors.**

Types EP and EPT transformers are the most reliable and safest transformers ever built. They cannot explode, no toxic gases can be released, and fire hazards are negligible.

These dry type transformers are used chiefly, for voltage transformation in the load area, of commercial, institutional, and residential structures. EP and EPT transformers are ideally suited for water and sewage treatment plants. Many other applications are found in industries such as pulp and paper, steel, cement, chemical and mining, and in shipboard distribution systems.

The "potted" construction of the types EP and EPT provides excellent protection against the effects of dust, moisture and corrosive vapour in all industrial applications.

Benefits

Location Anywhere: Safest for indoor location; most convenient for outdoor application. CSA approved for outdoor use. Upright mounting only for outdoor use)

Smallest Size: In cubic volume, a full size rating smaller than other dry type construction.

Low Sound Level: Westinghouse patented embedding technique results in lower noise levels.

Mounting Flexibility: Because the EP and EPT cools by radiation and ventilating, air paths are not required. They can be mounted in any position.①

Removable Front Panel Provides Large Vertical Working Space.

Design Features

Ecology Transformers

1. Case①

A sturdy steel case is provided for all ratings.

2. Sand-resin Embedding Compound

Embedding compound facilitates rapid transfer of heat from core and coil to the radiating surface and minimizes size and weight of unit.

3. Core and Coil Assembly

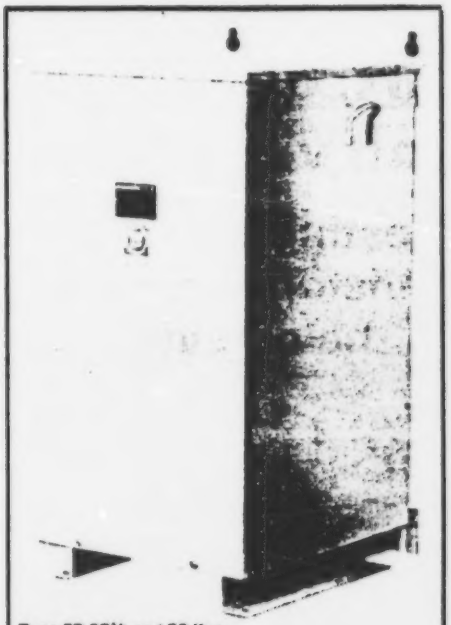
Low loss core and coil configuration with proper iron to aluminium ratios produces good regulation and high efficiency. Hipersil cores are used to insure superior magnetic performance.

4. Cable Leads and Terminals

All ratings up to 2 kVA are supplied with flexible cable leads. Above 2 kVA pressure terminals are included.

5. Wiring Compartment

Complete accessibility is provided by large capacity wiring compartments as indicated by the unit shown below.



Type EP 37½ and 50 Kva
Type EPT 45 Kva and 75 Kva

Application Data

	Type EP — Single Phase		Type EPT — Scott Connected — Three Phase		
Insulation Class **Temp. Rise (Coil)**	F 115°C		F 115°C		
kVA Ratings Available **Taps**	1 to 50 See price schedule		3 to 75 See price schedule		
Voltages Available ③	600-120/240 480-120/240	240 x 480-120/240 120 x 240-120/240	9 kVA and below 600-208T/120 480-208T/120	above 9 kVA 600-208Y/120 600-208Y/120	
% Impedance	kVA %	kVA %	kVA %	kVA %	kVA %
(Approximate)	1 4.2 1½ 3.7 2 3.4 3 3.2 5 2.4 7½ 1.5	10 2.0 15 1.4 25 3.0 37½ 3.2 50 3.7	3 4.2 6 3.0 9 3.0	15 2.4 30 1.9 45 1.9	75 3.0
Mounting Positions **Mounting Locations**	Wall, floor or ceiling Indoor or Outdoor		Wall, floor or ceiling Indoor or Outdoor		
Sound Level (Average)	40 db	45 db	40 db	45 db	50 db
Ventilation **Enclosure** **Conduit Entry** **Hanger Brackets**	Non-ventilated Steel Case Bottom and side k.o's① Integral		Non-ventilated Steel Case Bottom and side k.o's① Integral		
Connections	Removable bottom plate (1 to 25 kVA) or front panel (37½ and 50 kVA) to expose terminals		Removable bottom plate (3 kVA to 30 kVA) or front panel (45 and 75 kVA) to expose terminals.		

①It may be necessary to modify the mounting lugs and terminal cover for some arrangements.
②K.o's not available on 37½ & 50 kVA EP and 45 & 75 kVA EPT units
③Other voltages are available. Refer to factory.

DV Series Lighting Fixtures, Incandescent Hazardous Locations

Class II, Groups E, F, G①
Class III

Dust Ignition Proof

Application

DV Series fixtures can be used for:

Hazardous locations where suspended metal, carbon, (coal etc.) and grain dusts create explosive or ignitable mixtures with the air.

General, local or supplementary lighting of process, handling or storage areas for flour and feed mills, grain elevators, coal preparation plants, starch factories, confectionary manufacturing plants, powdered metal plants, etc.

Class III hazardous locations where fibers or flyings can settle to form fire hazards as woodworking or textile plants.

Features

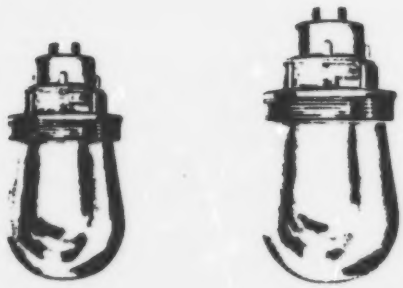
Low cost incandescent fixture for Class II and Class III hazardous locations.

Low operating temperature.

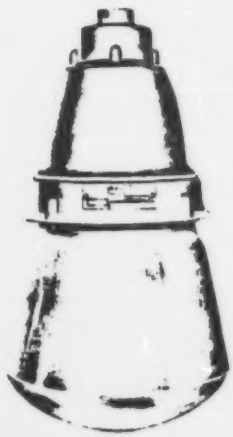
All joints and gaskets are dust tight.

Cast of corrosion resistant K-27 aluminum alloy (copper free-less than .4% copper). Aluminum lacquer finish.

Pendant and ceiling mounting arrangements. Ceiling mounting splice has four hubs in "X" configuration. Mounts directly to conduit. No mounting lugs.



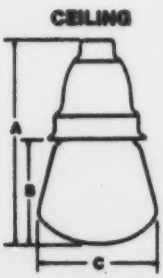
100 200



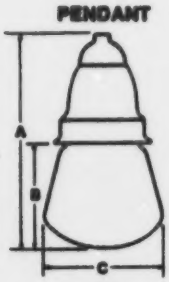
500

100-200

100-200



500



500

CATALOG NUMBERS

FIXTURE TYPE	LAMP SIZE	HUB SIZE	PENDANT	CEILING
100	100 WATT A-21 150 WATT A-23	½	DVA-110	DVX-110
		¾	DVA-210	DVX-210
200	150 WATT PS-25 200 WATT PS-25	½	DVA-120	DVX-120
		¾	DVA-220	DVX-220
500	300 WATT PS-35 500 WATT PS-35	½	DVA-130	DVX-130
		¾	DVA-230	DVX-230

DIMENSIONS

FIXTURE TYPE	100			200			500		
	A	B	C	A	B	C	A	B	C
PENDANT	9⅛	6	4½	10⅛	6⅛	5⅛	15⅛	7⅛	8
CEILING	8⅛	6	4½	9⅛	6⅛	5⅛	14⅛	7⅛	8

① Fixture type 500 suitable for Groups E, F when using 500 watt lamp.

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DV Series Accessories and Replacement Parts

Reflectors

Steel, White Porcelain Enamel

SHALLOW

STANDARD DOME

ANGLE

CATALOG NUMBERS

REFLECTOR TYPE	FIXTURE TYPE 100 CATALOG NUMBERS	100 DIAMETER	200 CATALOG NUMBERS	200 DIAMETER	500 CATALOG NUMBERS	500 DIAMETER
STANDARD DOME	DRSD-100	12	DRSD-200	16	DLRSD-20	16
SHALLOW	DRS-100	12	DRS-200	16	DLRS-20	16
ANGLE	DRA-100	10	DRA-200	16	DLRA-20	16

Globes

100

200

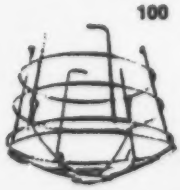
500

FIXTURE TYPE	CATALOG NUMBER
100	DCGS-10
200	DCGS-20
500	DCG-20

Guards ⓘ

100

200



500

FIXTURE TYPE	CATALOG NUMBER
100	DAG-100
200	DAG-200
500	DLH-20

ⓘ Fixture types 100 and 200; Guards cannot be used with reflectors. Fixture type 500; Guard cannot be used with angle reflector.

Replacement Receptacles

FIXTURE TYPE	CATALOG NUMBER
100 200	VRME
500	VRMO

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5-74(R)

SECTION 9

INSTRUMENTATION DETAILS AND DRAWINGS

9.0 INSTRUMENTATION DETAILS AND DRAWINGS

9.1 General Specifications

9.1.1 Scope

This Specification defines the general requirements for the vendor's design, selection of materials and documentation associated with the measuring instruments and the Central Control System (CCS) furnished for the D.S.S. Mobile Unit.

This Specification should be read and interpreted together with the attached detailed specifications. In case of variations between this specification and the detailed specification, the requirements of the latter will take precedence.

9.1.2 Control System Overview

The purpose of the mobile plant is to study and improve the operation of existing coal cleaning facilities, on-site.

The mobile plant has been designed to demonstrate a number of process options to treat fine coal.

By utilizing 5 removable and interchangeable modules, which can be installed in addition to a permanent module on a drop deck trailer, the mobile unit can simulate 7 process circuit options of two pre-selected processes.

The measuring and control system will measure the given process variables in each and every option and provide continuous monitoring of the solids distribution throughout the process circuitry.

The local instruments will be mounted within the process modules. Instruments within the permanent module will be permanently wired to the central control system. Instruments within the removable process modules will be equipped with weatherproof connectors for quick installation or removal.

On the leading end of the trailer, there will be an air-conditioned control room, which will house the electrical and process control equipment (Ref. Dwg. No. 42022-I-01).

9.1.3 Codes and Standards

All materials, ratings and methods of construction shall meet or exceed the requirements of the national regulatory agencies or standard associations which has jurisdiction over, or have set up recognized standards for the specified service or installation.

As a minimum, all instruments shall be constructed to comply with the latest applicable requirements of the following codes and standards:

- Canadian Standards Association (C.S.A.)
- Canadian Electrical Code
- The Institute of Electrical and Electronic Engineers (I.E.E.E.)
- Electrical and Electronic Manufacturers Association of Canada (EEMAC)

9.1.4 Design Requirements

9.1.4.1 General

All local instrumentation and control devices and their accessories shall be heavy duty industrial type. They shall be able to operate reliably under the specified process and ambient outdoor conditions.

The expected ambient conditions area as follows:

	Process Area (Note 1)	Control Room (Note 2)
Temperature	-3 to 40°C	15 to 30°C
Temperature Shock	0.2°C/min	0.3°C/min
Humidity	0-100% RH	50-70% RH
Ambient RFI	10 v/min	10 v/min
Dust Concentration	Not Defined	Low
Vibration	(Note 3)	(Note 4)

Notes: 1) The plant is not designed for winter operations.

2) The conditions listed are applicable only when the unit is in operation and the control room air conditioning system is running, otherwise the CCS is subject to the Process Area Ambient Conditions.

3) The mobile unit is expected to travel on secondary, unpaved roads. All equipment in the process area will be rigidly mounted on equipment or on supporting brackets, using the supplier's standard mounting recommendations. Where this is not acceptable, the supplier shall provide special mounting provisions.

4) The control panel enclosure will be rigidly bolted to the control room floor and to the wall. The panel supplier shall ascertain that all panel mounted equipment is individually isolated from the panel structure by suitable shock mount.

Heating or purging of instruments for environmental reasons shall not be considered.

All control loops within the mobile plant will be monitored and controlled from a central control system. all instrumentation connected with this system shall be electronic type.

Control signal levels shall be:

4-20 mA DC for analog and
120 V AC for discrete type controls.

Only 120 V AC single phase electrical power is available for the control system. Instrument air or purge water are not available.

Units will be:

Flow (liquid)	m^3/h
Liquid Level	% of range
Temperature	°C
Mass	tonne
Mass Flow	tonnes/h
Composition	% by mass

Scales and printouts will be in Engineering Units except for liquid levels (same as units of measurement)

All items containing electrical or electronic components shall be CSA approved.

9.1.4.2 Construction

All local instruments shall be housed in corrosion resistant, weather proof enclosures with the manufacturer's standard finish.

All local instruments shall be supplied with mounting brackets, suitable for surface or 2" pipe stand mounting.

Screw type terminal strips shall be provided for all electrical or electronic connections.

9.1.4.3 Instrument Location

With the exception of the magnetic flowmeters, all field instruments comprise of two components, i.e.:

- sensing device and transmitter for measurements
- controller and valve with operator for control valves

The sensing elements and valves will be located directly in the process piping or on process equipment following the manufacturer's recommendation for reliable measurement.

The transmitters and valve controllers will be mounted in the process area either near their corresponding sensing element as for the level transmitters, and control valves or on two transmitter racks as for the conductivity and mass flow measurements.

Care shall be taken to provide good accessibility to all transmitters.

The level, mass flow and conductivity measuring instruments shall be supplied with prefabricated cables to connect the sensing device to the transmitter. These cables shall be cut to the proper length and installed according to the supplier's instructions.

9.1.5 Central Control System

9.1.5.1 Control Units

The central control system shall be built around one or more microprocessor based controllers with all functions performed on a time shared basis.

Every control module shall be self contained and shall have its own:

- Memory
- CPU
- A/D converter/multiplexer
- D/A converter
- Direct access provision to the memory from the data communication system
- Trend memory.

The control units shall perform all conventional process control and arithmetic functions including:

- 3 mode control (P I D)
- Cascade, ratio and bias capabilities
- Lead/lag compensation
- Signal linearization for square root, thermocouple and minimum 8 point random curve type inputs
- Adjustable time based input signal noise filter
- Manual - Auto - Supervisory mode of operation with totally bumpless switching between modes either automatic or operator initiated
- Basic arithmetic functions, like: high/low select, add, multiply and divide
- Reset anti-windup feature
- High, low process input alarms for either absolute or deviation settings.

The controller units shall also provide counting, timing and interlocking logic functions. The timing and counting shall have the capability of continuous timing and setpoint up-date to suit current system requirements.

All the basic control and arithmetic functions shall be resident in non alterable memory in every control unit. These memory modules shall be factory programmed and program tested.

The loop configuration which includes the selection of control and arithmetic functions, the assignment of tuning constants, limits, etc. shall be easily alterable by external means. All this configuration data shall be resident in the control units.

All nondynamic data (i.e. loop configuration, tuning constants, limits, etc.), shall be stored in non-volatile memories.

All analog control inputs to the controllers shall be 4-20 mA DC. These signals may or may not be linear.

The local transmitters, may operate as true 2 wire transmitters or as 4 wire transmitters. The Central Control System shall be capable of supplying regulated power to the local field transmitters or provide isolation for powered inputs as required.

The failure of a controller shall result in the output going to one of three pre-selectable points which are:

- 0% output
- last value output
- 100% output.

The input resistance of discrete input modules which are to be interfaced with field contacts and switches shall be adjusted to allow for the flow of 'wetting' current through the contacts equal to 5 to 12 mA at operating voltages.

All output modules designed to drive inductive loads shall be protected against voltage transients caused by the collapse of the current at the above specified loads.

9.1.5.2 Data Communication

The communication between the control system, its auxiliaries and the operator's interface shall be through a dedicated, hard wired network. All communications shall be done in digital mode, with maximum security, including bit-by-bit checking, error detection code, etc.

The communications network shall be backed-up by a fully redundant system with instantaneous switchover in case of component failure in the primary system. The switchover shall be automatic and shall not interrupt the operation of the system. The operator shall be immediately notified of the switchover.

If primary and back-up systems are used, the switch back to the primary network shall be operator initiated.

The back-up, non-active network shall be continuously exercised to prove its availability. In case of fault detection in either network, the operator shall be immediately notified.

In addition to the internal system communication network, a standard RS232 compatible serial asynchronous data port, capable of a minimum of 9,600 baud data communication rate shall be provided. Supplier shall list the hardware and software interface to personal computers that already exist and also mention related forecasted developments.

Through this interface there shall be a two way direct access to all process and system configuration data to permit the reading and modification of any parameter.

9.1.5.3 Operator's Interface

The Operator's Interface shall provide software based man-machine communication only. There shall be no automatic process control, interlocking or data acquisition functions in this system.

The Operator's Console shall consist of:

- Cathode Ray Tube (CRT)
- Operator's Keyboard
- Programmer Keyboard (may be integral with the Operator's Keyboard)
- Hard Copy Printer

The CRT shall have a minimum of 8 colours display capability.

The CRT shall communicate with the operators through the use of simple, easy to comprehend symbols and abbreviations, conventional tag numbers, standard engineering units and English language notes and descriptions.

CRT displays shall be built on a hierarchial structure, consisting of the following displays as a minimum:

- Plant overview showing the status of all inputs of a given process circuit option.

- The more detailed view of smaller groups selected from the overview, to show the input, set oint and output, as applicable, of each controller or other functional instrument in the group.

- Single loop display to show all tuning information about any selected loop.

- Short term trends consisting of readings averaged every one minute for a period of one hour.

- Medium-term trends consisting of readings averaged every one hour for a period of 24 hours.

- Long term trends consisting of readings averaged every one hour for a period of four days.

- Presentations of unacknowledged alarms on a priority basis regardless of current CRT display.

- Listing of alarm summary on demand.

- Generation of operator designated reports either automatically at specified times or on demand.

- Support of customer generated "live" colour graphics capability. This program shall include a multi-page library for customer built standard graphics symbols which can be called upon to speed up the "drawing" of graphics. The multi-coloured graphics shall be dynamic, showing the general behaviour of the pro cess, change of levels in vessels, positions of control valves, alarm conditions, etc. The building and modification of the graphics shall be facilitated through the keyboard.

- The operator shall be able to control the process through the graphic displays.

CRT and report contents shall be stored on a medium not susceptible to power interruption so that display and reports can be easily recovered following a power interruption.

The Operator's Keyboard will be the primary means of access to the system memory files by the operators and engineering personnel.

The Operator's Keyboard shall provide a two (2) level, key lockable access to all process control related configuration and data base.

In addition to the Supplier designed customized functions, the keyboards shall contain a full ASCII character set.

A hard copy line printer shall be provided for the process control system. This printer shall be capable of printing the complete ASCII set of characters, producing tables, charts, and graphics, duplicating them as they are shown on the CRTs.

9.1.5.4 Programming

The system shall be "user friendly", and easy to program. The operating and maintenance personnel shall not be subjected to any general purpose computer programming language like FORTRAN or COBOL or such.

Provision shall be made to enter prerecorded alphanumeric messages, based on a complete ASCII character set. These messages shall appear automatically to:

- guide the Operator through the initial set-up and verification procedure for a selected process option by "questions and answers".

- inform the operator of pre-selected status changes.

These prerecorded messages shall be included together with the user configuration and loaded into the system at the same time.

The programming shall be accomplished by entering the program manually or by first recording the program on a magnetic media and then loading it at the appropriate time via programming panel. The program or configuration shall be provided with memory protect feature to prevent unauthorized personnel from performing program modifications.

9.1.5.5 Panel Design

The control panel enclosure shall be a rigid, self- supporting structure, with suitable structural steel reinforcement, stiffening and bracing. After the structure is assembled, the surfaces shall be flat and smooth and shall have ample strength to withstand all stresses encountered in shipping, installation and during the transportation of the mobile unit without distortion, vibration or other damage.

The structure shall be complete with removable lifting lugs. Special provision shall be provided to fasten the control panel to the floor of the control room, as detailed in the detail specification.

Doors and/or removable sections shall be provided in accordance with the layout drawing.

All surfaces to be shop painted. They shall be clean, dry, and free of loose scale, rust, dirt, weld spatter and other loose particles which shall be removed in accordance with applicable codes and standards or other methods approved by Partec.

Before painting all surfaces must be cleaned with a lacquer thinner.

After cleaning, all surfaces shall be given one coat of primer.

Following priming, all surfaces shall be finish sanded, exterior indentations filled, and a full coat of sand glazer or surfacer applied.

Exterior surfaces shall be wet sanded smooth with No. 280 wet or dry paper, followed by two coats of finish paint.

Inside surfaces shall be given one coat of white finish paint.

The colour of finish coating shall be the Supplier's standard.

The Supplier shall supply 1 quart of each colour paint used, for field touch-up. The touch-up paint shall be from the same batch of paint as that used to paint the panel.

The control panel shall be completely wired, and assembled, with all instruments, devices and controls installed so that the entire assembly is an operable unit ready for installation. The instrument and control terminals shall be wired to terminal blocks for outboard or field connection.

The keyboard, CRT and any other controls, instruments and devices mounted on the front of panels or enclosures shall be flush mounted.

All devices to which an address or physical location identification is assigned on the drawings shall have that number permanently marked on the case. "Dymo" tape identification is not acceptable.

Nameplates shall be laminated plastic with white face and black core, unless other colours are specified on an individual basis.

All panel and console mounted instruments, controls and other devices shall have their identifications duplicated on the interior of the panel structure immediately adjacent to their locations. Identification shall be clearly visible from inside the panel enclosure.

Terminal blocks for power, 120 V AC shall be pressure bearing plate type, 600 V rated. For lower voltage services pressure bearing plate type, 300 V rated terminal blocks shall be used.

All terminal blocks shall be mounted in easily accessible locations and shall allow adequate space for handling and terminating cables. The terminal blocks shall be furnished with spare terminals, spaced equally along the terminal strips.

Terminal blocks shall be grouped by interconnecting cables designated and segregated according to circuit voltage.

The terminal blocks shall be furnished with individual markers on both sides, marked by the Supplier in accordance with the design documentation.

A maximum of two (2) wires per terminal shall be connected on either side of these blocks. All common connections shall be made on the equipment side of the terminal blocks.

All annunciator, control and power supply wiring shall be stranded copper single conductor #16 AWG wire unless otherwise specified. Wire insulation shall be 600 V rated in accordance with the appropriate CSA specification.

The Control Panel wiring shall be colour coded as follows:

Annunciator (if used)	Red
Instrument Switch-Alarms	Red
Instrument Switch-Interlocks	Orange
Motor Control	Yellow
AC Power Hot	Black
AC Power Neutral	White
Grounds	Green
DC Control	Blue

All low level electronic instrumentation wiring shall be #18 AWG, tinned copper, polyethylene insulated twisted pairs with #20 AWG drain wire and shall be run in separate raceways.

Solderless compression ring lugs with uninsulated ferules shall be used for all wiring connected to open screw type terminals.

Each wire within the panel shall be marked at both ends with wire markers. Wire markers shall be permanently embossed heat shrinkable sleeve markers; wrap around tape markers are not acceptable.

Horizontal and vertical wiring between the terminal blocks and the devices shall be enclosed in raceways. Plastic materials used in raceways shall be flame retarding, and shall be Panduit wiring duct, Taylor wiring duct or equal. Wire fill in raceways shall not exceed 75% capacity. After completion of the panel checkout all wiring shall be pushed down to the bottom of the raceways and fastened to eliminate vibration.

Wiring between the raceways and the devices may run exposed for distances not exceeding 6 inches.

All exposed wiring shall be formed neatly with wires grouped in packs. Each pack shall be bound with plastic ties similar to T & B "TY- RAP" and shall be substantially supported throughout the board and raceways. Cabled wire is not acceptable.

The panel shall be internally lighted by suitably located, shielded and guarded fluorescent lamps. A switch shall be provided convenient to the access door to control the interior lighting. The lamps shall be wired to a circuit breaker.

In addition to supplying regulated power to the "2 wire" local transmitter as per para ix of section 9.1.5.1, the CCS shall have a partitioned terminal section to provide 110 V AC unregulated power to the instrumentation field devices, including control valves, as shown on the loop diagram. Each field instrument circuit shall be individually protected by the use of fused terminals.

The CCS and the field instrumentation power supplies shall be fed from separate feeders.

Special care shall be taken to provide sufficient filtering for the control panel ventilation system. Cabinet interior over temperature alarm shall be provided to indicate overheating caused by ventilation failure, filter blockage or high ambient temperature. The temperature alarm shall be set to below equipment damage temperature and the alarm condition shall be reported through the system.

9.1.5.6 Grounding

The control panel shall be equipped with a solderless clamp type terminal lug bolted to the structure, to accept a #1/0 AWG bare stranded copper ground cable. The ground lug shall be located inside, near the bottom and shall maintain high pressure metal to metal contact with the structure.

The control panel shall be equipped with a 1/4 inch x 1 inch copper ground bus extending its entire length, installed inside, bolted to, but insulated from the structure. This ground bus shall be used for all cable shields and instrument ground applications. A solderless clamp-type terminal lug shall be shall be provided at each end of the ground bus to accept a #1/0 AWG bare stranded copper ground cable.

The cases of panel mounted devices shall be grounded effectively through the steel structure.

Wherever the schematics or loop diagrams indicate a definite ground for a circuit at the structure, a single wire for each circuit thus grounded shall be run independently to the ground bus and fastened thereto with a drilled and tapped connection.

9.1.6 Hardware Documentation

Outline Dimension and Mounting Detail drawings shall be submitted for every individual piece of equipment included in this order, which will be shipped separately and requires installation.

Assembly and Internal Arrangement Drawings showing the physical arrangement of all devices shall be furnished for the control panel. The function of each device shall be shown on this drawing.

The control panel supplier shall provide Interconnection Schematic Diagrams showing the interconnections of every device in the system. These shall be suitable for trouble-shooting and maintenance of the system.

The control panel supplier shall provide a complete Power Distribution and Grounding Diagram showing all ac and dc power distribution, fusing and grounding within.

Terminal Connection Drawings showing the terminal blocks where the field connections are to be made shall be furnished. These drawings shall show terminal numbers, connector numbers, identify blocks of terminals and connectors as to type (input, output, analog, digital, etc.).

9.1.7 Software Documentation

The control panel supplier shall submit the complete software documentation for every custom developed pro gram in the system including, but not limited to, libraries, subroutines, monitors, executives, diagnos tics, and application progams.

A list of Acronyms alphabetically listing all acronyms and other variable names and their meanings shall be furnished.

Program Flow Charts shall also be included. A flow chart shall be furnished for every custom developed program in the system. Each flow chart shall be cross-referenced to a standard software block diagram showing the relationship of that program to the entire system.

Flow charts shall show the sequence of the program; logic operations; decision blocks; read, store and write operations, and calcuations. All written descriptions within the flow chart blocks shall be in English.

Programmer's Manual shall be furnished for each assembler, compiler or other such control system furnished. This manual shall explain all machine instructions and programmer actions required to utilize the compiler, assembler, or other systems and list and explain all functions available to the programmer.

A separate instruction book called the Operator's Instruction Manual shall be furnished for use by the plant operators. This book shall list and explain all functions available to the operators at the operator's console.

A written description shall accompany each diagnostic program explaining in detail the fault recognition, location and correction procedure.

9.1.8 Testing

Prior to shipment, each vendor shall perform a complete test of his equipment.

The vendors shall ascertain that all instruments are properly calibrated.

Prior to shipment, complete functional tests shall be performed on the complete control panel.

The same functional tests shall be performed on the control panel after installation.

The functional tests shall include, but not be limited to, the following, as applicable:

These analog control loops are shown on Loop Diagrams 42022-I-03, Sheets 1 thru 7.

Every one of the above control loops require one analog input and one analog output each.

iii) Trending

The following variables shall be trended:

FR-01P; 02P; 03P; 04P; 05P; 06P; 07P (direct values)
MR-01P; 02P; 03P; 04P; 05P; 06P; 07P (direct values)
SR-01P; 02P; 03P; 04P; 05P; 06P; 07P (calculated values) FR-01S; 02S; 03S; 04S; 05S; 06S; 07S (calculated values) MR-01S; 02S; 03S; 04S; 05S; 06S; 07S (calculated values) SR-01S; 02S; 03S; 04S; 05S; 06S; 07S (calculated values) QR-01S; 02S; 03S; 04S; 05S; 06S; 07S (direct values)
WR-01S; 02S; 03S; 04S; 05S; 06S; 07S (calculated values) FR-01W; 02W; 03W; 04W; 05W; 06W; 07W (calculated values) MR-01W; 02W; 03W; 04W; 05W; 06W; 07W (calculated values) QR-01W; 02W; 03W; 04W; 05W; 06W; 07W (calculated values) FR-09 and FR-10 (direct values)

The trending frequency shall be based on the following:

20 second averages up to 5 minutes
1 minute averages up to 1 hour
1 hour averages up to 24 hours

- Check of all panel mounted devices to ensure that they are securely attached.

- Check of all terminal blocks and interconnecting wiring to ensure that they are firmly secured and have covers where applicable.

- 100 percent point-to-point continuity tests and electrical insulation tests in accordance with the requirements of ANSI C37.20, Section 5. Megger or other high voltage tests shall not be applied to any co-axial or tri-axial cables.

- Individual electronic instrument control loop testing by connecting an input signal of the correct range to the panel input terminals in the shop, and by using the actual transmitters after installation.

- Analog controller output signal vertification with an appropriate output load and meter in the shop, and by stroking the valve or varying the pump speed after installation.

- Electrical contact output signals checks at the rated voltage.

- Control circuit function tests which shall be performed by actuating control switches and pushbuttons during application of appropriate signals while observing the functioning of all associated panel and console devices and checking for proper output signals.

- All annunciator wiring testing, if any, by simulating the external alarm contact position during alarm and normal conditions.

- Pushbuttons, selector switches, relays and other control voltage devices checks for the operation and correctness of wiring. All circuits which are not to be grounded shall also be checked to ensure that they are free of grounds.

All direct values require one analog input except the FR-01P to FR-04P; FR-06P and FR-07P inputs which are common with the analog flow control loops.

Calculated values will be derived as detailed in section 9.2.7.6.

iv) Totalizing

The following variables shall be totalized in operator resetable totalizers:

FQ-01P; 02P; 03P; 04P; 05P; 06P; 07P (direct input)
MQ-01P; 02P; 03P; 04P; 05P; 06P; 07P (direct input)
FQ-01S; 02S; 03S; 04S; 05S; 06S; 07S (calculated value)
MQ-01S; 02S; 03S; 04S; 05S; 06S; 07S (calculated value)

None of the above totalizers need separate analog input.

v) Pump Discharge Stream Analysis

The calculated values which are to be trended or totalized shall be derived from direct analog inputs using pre-programmed mathematical equations. All calculations shall take place on real time basis and shall be available for printout at any time.

Analog inputs:

- The following analog inputs will be available:

Slurry (pulp) Volumetric Flow:	FX-0ZP
Slurry (pulp) Mass Flow:	MX-0ZP
Percent Water in Slurry by Volume:	QX-0ZW

9.2 Detailed Specifications

9.2.1 General

This section of the Specification defines the specific requirements for the instrumentation and control system for the D.S.S. Mobile Unit.

This section shall be read and interpreted together with the Instrument Index in Section 9.3.

The Instrument Index contains all instruments and functions required to operate the Mobile Unit. In general the tag numbers relating to local instrumentation coincide with the actual hardware items, while the tag numbers relating to the CCS describe functions. These functions may be generated by direct input or they may be the result of mathematical calculations, performed by the CCS itself.

With the exception of the CCS, all layouts, arrangements and the instrumentation performance are based on specific manufacturers as listed on specific manufacturerers as listed in this section. If the engineering company undertaking the construction of the mobile plant elects to select othear equipment than specified, FENCO will not be in the position to guarantee the performance of the complete control system.

9.2.2 Level Measuring Devices

These level measuring devices shall be ultrasonic type, with separate sensing head and transmitter.

The transmitter shall have a digital read-out which can be read either in engineering units or percent scale.

The level measuring devices shall have the following general specifications with specific requirements as detailed in Table 9.1

Quantity:	8
Manufacturer:	Milltronics
Model No. or Type:	Micro Ranger
Description:	Ultrasonic Type Liquid Level Transmitter c/w Sensing Head
Area Electrical Class:	General Purpose
Power Supply:	110 V. 60 Hz
Sensor Face Material:	Epoxy
Sensor Flange Material:	316 S.S.
Transmitter Case:	EEMAC 4
Transmitter Mounting:	Remote, Surface
Transmitter Output/Calibration:	4-20 mA Linear./0-100%
Max. Pressure:	100 kPa
Operating Temperature:	Ambient

Options:
- Digital Readout on Transmitter
- 5.0 meters of connecting cable between sensing head and transmitter

TABLE 9.1

LEVEL MEASURING DEVICES

Tag No.	Service	Range Fluid
LE/LT-01	Sump #1 Level Meas.	0-900 mm Water/Coal Slurry
LE/LT-02	Sump #2 Level Meas.	0-900 mm Water/Coal Slurry
LE/LT-03	Sump #3 Level Meas.	0-680 mm Water/Coal Slurry
LE/LT-04	Sump #4 Level Meas.	0-680 mm Water/Coal Slurry
LE/LT-05	Sump #5 Level Meas.	0-900 mm Water/Coal Slurry
LE/LT-06	Conditioner #1 Level Meas.	0-830 mm Water/Coal Slurry
LE/LT-07	Conditioner #2 Level Meas.	0-830 mm Water/Coal Slurry
LE/LT-08	Clarified Water Head Tank Level Meas.	0-630 mm Clarified Water

9.2.3 Volumetric Flow Measuring Devices

The volumetric flow measuring devices shall be magnetic flow meter type, with integral transmitter.

The measuring tube shall be wafer type, suitable for mounting in between two 150 lbs raised face flanges.

The liner material shall be selected to provide maximum wear on the specified water/coal slurry.

The volumentric flow measuring devices shall have the following specifications, with specific requirements as detailed in Table 9.2.

Quantity:	9
Manufacturer:	Fischer & Porter
Model No. or Type:	"Mini-Mag"
Description:	Magnetic Flowmeter c/w integrally Mounted Transmitter
Area Electrical Class:	General Purpose
Power Supply:	110 V. 60 Hz
Meter Tube/Liner Materials:	Carbon Steel/Teflon
Flange Material:	150 lbs Rated Wafer Type
Electrode Material:	Zirconium
Meter/Transmitter Housing:	EEMAC 4
Transmitter Mounting:	Remote, Surface
Transmitter/Calibration:	4-20 mA, Linear/Eng. Units
Max. Pressure:	100 kPa
Operating Temperature:	Ambient
Options:	None

TABLE 9.2

VOLUMETRIC FLOW MEASURING DEVICES

Tag No.	Service	Fluid Meter Size % Solids by Volume	Norm Flow Min/Max Flow m^3/h
FT-01	Pump #1 discharge flow	Water/Coal Slurry 2" 5-12	13.64 8.2 - 15.0
FT-02	Pump #2 discharge flow	Water/Coal Slurry 2" 5-12	13.64 8.2 - 15.0
FT-03	Pump #3 discharge flow	Water/Coal Slurry 1½" 6-15	5.0 5.0 - 15.0
FT-04	Pump #4 discharge flow	Water/Coal Slurry 1" 5-10	1.36 1.36 - 3.00
FT-05	Pump #5 discharge flow	Water/Coal Slurry 2" 0.8 - 1.0	N/A 12.0 - 25.0
FT-06	Pump #6 discharge flow	Water/Coal Slurry 2" 5-12	13.64 8.2 - 15.0
FT-07	Pump #7 discharge flow	Water/Coal Slurry 1½" 5-12	6.75 5.0 - 7.4
FT-09	Water Tank Make-Up Flow	Clarified Water 2" 0	N/A 0 - 12
FT-10	Dewatering Unit discharge flow	Filtered Water 1" 0	N/A 0 - 4

9.2.4 Mass Flow Measuring Devices

The mass flow measuring devices shall be the vibrating tube type, with separate transmitter.

These devices shall be located in the main process flow. Sampling devices are not acceptable.

The metering tube shall be lined with erosion resistant material to the maximum thickness which will not affect the accuracy of the reading.

The mass flow measuring devices shall havea the following general specifications, with specific requirements as detailed in Table 9.3.

Quantity:	7
Manufacturer:	Micromotion
Model No. or Type:	Ref. Table 9.3
Description:	Vibrating Tube Type Sensor c/w Remote Transmitter
Area Electrical Class:	General Purpose
Power Supply:	110 V. 60 Hz
Meter Tube Material:	Halar lined 316L S.S.
Flange Material/Rating:	316 S.S./150 lbs RF
Meter/Transmitter Housing:	EEMAC 4/EEMAC 4
Transmitter Mounting:	Remote, Surface
Transmitter Output:	4-20 mA Linear
Max. Pressure:	100 kPa
Operating Temperature:	Ambient
Options:	
- 20.0 meters of connecting cable between the measuring tube and transmitter	

TABLE 9.3

MASS FLOW MEASURING DEVICES

Tag No.	Service	Fluid Meter/Tube Size Model	Norm Flow Min/Max Flow m^3/h	Norm S.G. Min/Max S.G. % Solids by Volume
ME/MT-01	Pump #1 discharge mass flow	Water/Coal Slurry 3"/2" D300H	13.64 1.2 - 15.0	1.05 1.03 - 1.10 5-12
ME/MT-02	Pump #2 discharge mass flow	Water/Coal Slurry 3"/2" D300H	13.64 8.2 - 15.0	1.05 1.03 - 1.10 5-12
ME/MT-03	Pump #3 discharge mass flow	Water/Coal Slurry 3"/2" D300H	5.0 5.0 - 15.0	1.05 1.03 - 1.10 6-15
ME/MT-04	Pump #4 discharge mass flow	Water/Coal Slurry 1½"/1" D150H	1.36 1.36 - 3.00	1.05 1.03 - 1.10 5-10
ME/MT-05	Pump #5 discharge mass flow	Water/Coal Slurry 3"/2" D300H	N/A 12 - 25	N/A 1.005 - 1.05 0.8 - 1.0
ME/MT-06	Pump #6 discharge mass flow	Water/Coal Slurry 3"/2" D300H	13.64 8.2 - 15.0	1.05 1.03 - 1.10 5-12
ME/MT-07	Pump #7 discharge mass flow	Water/Coal Slurry 1½"/1" D150H	6.75 5.0 - 7.4	1.05 1.03 - 1.10 5-12

9.2.5 Solids Concentration Measuring Devices

Specially calibrated, rotating field type conductivity measuring devices shall be used to measure the solids concentration in the pulp.

These measuring devices shall be located in the main process flow. Sampling devices are not acceptable.

These measuring devices shall havea the following general specifications, with specific requirements as detailed in Table 9.4.

Quantity:	7
Manufacturer:	Auburn
Model No. or Type:	Model 1080
Description:	Rotating field conductivity meter c/w transmitter
Area Electrical Class:	General Purpose
Power Supply:	110 V. 60 Hz
Meter Tube/Electrode Materials:	Carbon Steel/304 S.S.
Meter End Connections/Ratings:	150 lb RF Flg.
Transmitter Housing/Mounting:	EEMAC 4/Surface Remote
Transmitter Output:	4-20 mA, Linear
Max. Pressure:	100 kPa
Operating Temperature:	Ambient
Options:	
- 20.0 meters of connecting cable between the measuring run and the transmitter	

TABLE 9.4

SOLIDS CONCENTRATION MEASURING DEVICES

Tag No.	Service	Fluid Meter Size % Solids by Volume	Min/Max Flow m^3/h	Min/Max S.G.
AE/AT-01	Pump #1 discharge solids conc.	Water/Coal Slurry 2" 5-12	8.2 - 15	1.03 - 1.10
AE/AT-02	Pump #2 discharge solids conc.	Water/Coal Slurry 2" 5-12	8.2 - 15	1.03 - 1.10
AE/AT-03	Pump #3 discharge solids conc.	Water/Coal Slurry 1½" 6-15	5.0 - 15.0	1.03 - 1.10
AE/AT-04	Pump #4 discharge solids conc.	Water/Coal Slurry 1" 5-10	1.36 - 3.00	1.03 - 1.10
AE/AT-05	Pump #5 discharge solids conc.	Water/Coal Slurry 2" 0.8 - 1.0	12 - 25	1.005 - 1.05
AE/AT-06	Pump #6 discharge solids conc.	Water/Coal Slurry 2" 5-12	8.2 - 15.0	1.03 - 1.10
AE/AT-07	Pump #7 discharge solids conc.	Water/Coal Slurry 1½" 5-12	5.0 - 7.4	1.03 - 1.10

9.2.6 Control Valves

All control valves shall be wafer body heavy duty butterfly type, with resilient seat as specified below and shown in Table 9.5.

Quantity:	7
Manufacturer:	DeZurik
Model No. or Type:	Fig 632 LB RS50 3 KWGMI AC 84-135
Description:	
Body Matl./Type:	Semi Steel/Butterfly
Process Conn. (type, rating):	Lug, Wafer/150 lb RF Flg.
Sealing Class:	N/A
Type of Disk/Pinning:	STD/STD
Disk Mtl./Seat Mtl.	316 S.S. Neoprene
Packing Mtl./Stem Mtl.	STD/316 S.S.
Actuator Type/Signal in:	Electric Modulating 4-20 mA
Signal Funct./Fail Pos.:	N/A/Last
Valve Cv:	Ref. Note 1
Power Supply:	100 V. 60 Hz single phase
Max. Dead End Pressure:	100 kPa
Operating Temperature:	Ambient

Options:

- Solid state proportional amplifier
- Extended duty drive (30 sec full stroke)
- Manual Override
- EEMAC 4 enclosure both for valve actuator and transmitter

Note 1: These control valves will be installed in low-pressure lines to maintain sump liquid levels. All valves are line size, and their Cv's are not critical.

TABLE 9.5

CONTROL VALVES

Tag No.	Service
LC/LV-01	Sump #1 Level
LC/LV-02	Sump #2 Level
LC/LV-03	Sump #3 Level
LC/LV-04	Sump #4 Level
LC/LV-05	Water Tank Level
LC/LV-06	Conditioner #1 Level
LC/LV-07	Conditioner #2 Level

9.2.7 Central Control System (CCS)

i) Construction:

The CCS shall be designed in accordance of Dwg. 42022-I-01. The outline dimensions given are for reference only. Special care shall be taken to consider the space limitations within the control room when these outline dimensions are finalized.

All access to the control panel internals shall be from the front via removable sections.

The panel enclosure will be rigidly fastened to the control room floor and to the control room wall. All equipment inside the panel, which are sensitive to vibration (ie during transport of the mobile unit) shall be mounted on vibration pads. If the permanent mounting of the CRT is not feasible, it shall be housed in a specially designed easily removable enclosure, which could be separately packed for transport.

ii) Analog Control

The CCS shall have the capability to control a minimum of twenty (20) PID loops, as follows:

LIC-01	LIC-07
FIC-01	FIC-07
LIC-02	LIC-08
FIC-02	LIC-09
LIC-03	Spare
FIC-03	Spare
LIC-04	Spare
FIC-04	Spare
LIC-05	Spare
LIC-06	
FIC-06	

In the above tags: X represents an undefined function (ie transmitter, recorder, etc.); Y represents the loop numbers, 0 to 7.

- For the purpose of the mathematical equations the function identifiers and loop numbers will not be used, thus:

Slurry (pulp) Volumetric Flow will be:	FP (m^3/hr)
Slurry (pulp) Mass Flow will be:	MP (tph)
Percent Water in Slurry by Volume will be :	QW(%)

Variable	Description	Calculation Formula
Specific gravity of slurry	SP (SX-OZP)	$SP = \frac{MP}{FP}$
Specific gravity of solids in slurry	SS (SX-OZS)	$SS = \frac{MP - \left(\frac{(FP \times QW)}{100}\right)}{FP - \left(\frac{(FP \times QW)}{100}\right)}$
Volumetric flow of water in slurry (m^3/h)	FW (FX-OZW)	$FW = \left(\frac{FP \times QW}{100}\right)$
Volumetric flow of solids in slurry; (m^3/h)	FS (FX-OZS)	$FS = FP - \left(\frac{FP \times QW}{100}\right)$
Mass flow of water in slurry (tonnes/h)	MW (MX-OZW)	$MW = \left(\frac{MP \times QW}{100}\right)$
Mass flow of solids in slurry (tonnes/h)	MS (MX-OZS)	$MS = MP - \left(\frac{FP \times QW}{100}\right)$
Percent of solids in slurry by weight	WS (WX-OZS)	$WS = \frac{MP - \left(\frac{FP \times QW}{100}\right)}{MP}$

vi) Logic

The CCS shall provide the process and drive interlocking and logic for all seven process circuit options.

The logic flow charts are shown on the attached drawings, Nos.: 42022-I-11 through -17.

The discrete inputs and outputs required for the above logic are listed under the Electrical Specification and Details in Section 8.2.1.

vii) System Set-Up and Check List

The process option to be tested must be physically assembled on the trailer at Devon, Alberta and all proper piping and cabling connections made. Upon arrival at site, a physical check of all equipment must be made and all connections made with the operating plant (ie water, power, raw slurry, tailings) and with dewatering rig (froth, filtrate).

The CCS will be used to prompt the operator in performing this check on a step-by-step basis.

Upon arrival at site, the CCS will have been without power. After power up the operator will:

- Load the required executive program to initialize the system.
- Load the appropriate program for the selected process option.
- The flowsheet of the selected process option shall appear on the screen.

The system shall now be ready for operation.

The executive program shall contain:

- Manufacturer's standard initialization instructions.

- Programs, formats, mathematical equations, etc. which are common to all process options.

Each process option program shall contain:

- Check-list as per Section 9.4.

- The proper set points and timing parameters for the given process option, to be established at a later date.

- The interlocking sequence applicable to the selected process option as per drawings: 42022-I-11 thru -17.

- The initialization or lock-out at the appropriate analog and discrete inputs/outputs.

All of the programs are expected to be developed by the CCS supplier, based on this specification and on additional input from the engineering company undertaking the construction.

9.2.8 Hard Copy Printer

A printer is required to provide hard copy operating conditions repeatedly at timed intervals yet to be firmly established but, say, every 15 minutes.

A printout is required of the 12 load points within the circuitry. This printout wants to be given together with mass balance figures.

Whenever a process parameter change is initiated via the computer this change wants to be recorded, i.e. conditioner status change, flow rate, etc.

9.3 Instrument Index

A complete list of the instruments is included in the following pages. This entire section of the report should be cross-referenced with this index.

INSTRUMENT INDEX

42022-IL-01

Legend: CCS - Central Control System (Control Room)
CONT.R. - Control Room

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Sump No. 1 Level Control	LE-01	Level Sensor	)	SUMP 1	
	LT-01	Level Transmitter	) Level Indication/Control	SUMP 1	Ultrasonic
	LIC-01	Indicating Controller	)	CCS	
	LC-01	Valve Actuator Controller		SUMP 1	
	LV-01	Control Valve	) Water Addition	SUMP 1	Motorized
Pump No. 1 Discharge Flow Control	FT-01	Flow Transmitter	) Volumetric Flow	PIPE 1	Magmeter
	FIC-01	Indicating Controller	) Indication/Control	PIPE 1 CCS	
	FR-01P	Trend (Direct)	Volumetric Flow of Slurry	CCS	
	FQ-01P	Totalizer (Direct)		CCS	
	SY-01	Converter	Pump No. 1 Speed Control	CONT.R.	
Pump No. 1 Discharge Stream Analysis	ME-01	Mass Flow Sensor	) Mass of Slurry Measurement	PIPE 1	
	MT-01	Mass Flow Transmitter	)	RACK 2	
	AE-01	Conductivity Sensor	) % Volume of Water Measurement	PIPE 1	
	AT-01	Conductivity Transmitter	)	RACK 1	
	MR-01P	Trend (Direct)	Mass Flow of Slurry	CCS	
	MQ-01P	Totalizer		CCS	
	SR-01P	Trend (Calculated)	Specific Gravity of Slurry	CCS	
	FR-01S	Trend (Calculated)	Volumetric Flow of Solids	CCS	
	FQ-01S	Totalizer		CCS	
	MR-01S	Trend (Calculated)	Mass Flow of Solids	CCS	
	MQ-01S	Totalizer		CCS	
	SR-01S	Trend (Calculated)	Specific Gravity of Solids	CCS	
	QR-01S	Trend (Calculated)	Percent Solids (Volumetric)	CCS	
	WR-01S	Trend (Calculated)	Percent Solids (by weight)	CCS	
	FR-01W	Trend (Calculated)	Volumetric Flow of Water	CCS	
	MR-01W	Trend (Calculated)	Mass Flow of Water	CCS	
	QR-01W	Trend (Direct)	Percent Water (Volumetric)	CCS	

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Sump No. 2 Level Control	LE-02	Level Sensor	)	SUMP 2	Ultrasonic
	LT-02	Level Transmitter	) Level Indication/Control	SUMP 2	
	LIC-02	Indicating Controller	)	CCS	
	LIC-02	Valve Actuator/Controller		SUMP 2	
	LV-02	Control Valve	) Water Addition	SUMP 2	Motorized
Pump No. 2 Discharge Flow Control	FT-02	Flow Transmitter	) Volumetric Flow	PIPE 2	Magmeter
	FIC-02	Indicating Controller	) Indication/Control	PIPE 2 CCS	
	FR-02P	Trend (Direct)	Volumetric Flow of Slurry	CCS	
	FQ-02P	Totalizer (Direct)		CCS	
	SY-02	Converter	Pump No. 2 Speed Control	CONT.R.	
Pump No. 2 Discharge Stream Analysis	ME-02	Mass Flow Sensor	) Mass of Slurry Measurement	PIPE 2	
	MT-02	Mass Flow Transmitter	)	RACK 2	
	AE-02	Conductivity Sensor	) % Volume of Water Measurement	PIPE 2	
	AT-02	Conductivity Transmitter	)	RACK 1	
	MR-02P	Trend (Direct)	Mass Flow of Slurry	CCS	
	MQ-02P	Totalizer		CCS	
	SR-02P	Trend (Calculated)	Specific Gravity of Slurry	CCS	
	FR-02S	Trend (Calculated)	Volumetric Flow of Solids	CCS	
	FQ-02S	Totalizer		CCS	
	MR-02S	Trend (Calculated)	Mass Flow of Solids	CCS	
	MQ-02S	Totalizer		CCS	
	SR-02S	Trend (Calculated)	Specific Gravity of Solids	CCS	
	QR-02S	Trend (Calculated)	Percent Solids (Volumetric)	CCS	
	WR-02S	Trend (Calculated)	Percent Solids (by weight)	CCS	
	FR-02W	Trend (Calculated)	Volumetric Flow of Water	CCS	
	MR-02W	Trend (Calculated)	Mass Flow of Water	CCS	
	QR-02W	Trend (Direct)	Percent Water (Volumetric)	CCS	

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Sump No. 3 Level Control	LE-03	Level Sensor	)	SUMP 3	Ultrasonic
	LT-03	Level Transmitter	) Level Indication/Control	SUMP 3	
	LIC-03	Indicating Controller	)	CCS	
	LC-03	Valve Actuator/Controller		SUMP 3	
	LV-03	Control Valve	) Water Addition	SUMP 3	Motorized
Pump No. 3 Discharge Flow Control	FT-03	Flow Transmitter	) Volumetric Flow	PIPE 3	Magmeter
	FIC-03	Indicating Controller	) Indication/Control	PIPE 3 CCS	
	FR-03P	Trend (Direct)	Volumetric Flow of Slurry		
	FQ-03P	Totalizer (Direct)		CCS	
	SY-03	Converter	Pump No. 3 Speed Control	CONT.R.	
Pump No. 3 Discharge Stream Analysis	ME-03	Mass Flow Sensor	) Mass of Slurry Measurement	PIPE 3	
	MT-03	Mass Flow Transmitter	)	RACK 2	
	AE-03	Conductivity Sensor	) % Volume of Water Measurement	PIPE 3	
	AT-03	Conductivity Transmitter	)	RACK 1	
	MR-03P	Trend (Direct)	Mass Flow of Slurry	CCS	
	MQ-03P	Totalizer		CCS	
	SR-03P	Trend (Calculated)	Specific Gravity of Slurry	CCS	
	FR-03S	Trend (Calculated)	Volumetric Flow of Solids	CCS	
	FQ-03S	Totalizer		CCS	
	MR-03S	Trend (Calculated)	Mass Flow of Solids	CCS	
	MQ-03S	Totalizer		CCS	
	SR-03S	Trend (Calculated)	Specific Gravity of Solids	CCS	
	QR-03S	Trend (Calculated)	Percent Solids (Volumetric)	CCS	
	WR-03S	Trend (Calculated)	Percent Solids (by weight)	CCS	
	FR-03W	Trend (Calculated)	Volumetric Flow of Water	CCS	
	MR-03W	Trend (Calculated)	Mass Flow of Water	CCS	
	QR-03W	Trend (Direct)	Percent Water (Volumetric)	CCS	

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Sump No. 4 Level Control	LE-04	Level Sensor	)	SUMP 4	
	LT-04	Level Transmitter	) Level Indication/Control	SUMP 4	Ultrasonic
	LIC-04	Indicating Controller	)	CCS	
	LC-04	Valve Actuator/Controller		SUMP 4	
	LV-04	Control Valve	Water Addition	SUMP 4	Motorized
Pump No. 4 Discharge Flow Control	FT-04	Flow Transmitter	) Volumetric Flow	PIPE 4	Magmeter
	FIC-04	Indicating Controller	) Indication/Control	PIPE 4	
	FR-04P	Trend (Direct)		CCS	
	FQ-04P	Totalizer (Direct)	Volumetric Flow of Slurry	CCS	
	SY-04	Converter		CCS	
			Pump No. 4 Speed Control	CONT.R.	
Pump No. 4 Discharge Stream Analysis	ME-04	Mass Flow Sensor	) Mass of Slurry Measurement	PIPE 4	
	MT-04	Mass Flow Transmitter	)	RACK 2	
	AE-04	Conductivity Sensor			
	AT-04	Conductivity Transmitter	) % Volume of Water Measurement	PIPE 4	
			)	RACK 1	
	MR-04P	Trend (Direct)			
	MQ-04P	Totalizer	Mass Flow of Slurry	CCS	
	SR-04P	Trend (Calculated)		CCS	
			Specific Gravity of Slurry	CCS	
	FR-04S	Trend (Calculated)			
	FQ-04S	Totalizer	Volumetric Flow of Solids	CCS	
				CCS	
	MR-04S	Trend (Calculated)			
	MQ-04S	Totalizer	Mass Flow of Solids	CCS	
				CCS	
	SR-04S	Trend (Calculated)			
			Specific Gravity of Solids	CCS	
	QR-04S	Trend (Calculated)			
	WR-04S	Trend (Calculated)	Percent Solids (Volumetric)	CCS	
	FR-04W	Trend (Calculated)	Percent Solids (by weight)	CCS	
	MR-04W	Trend (Calculated)	Volumetric Flow of Water	CCS	
	QR-04W	Trend (Direct)	Mass Flow of Water	CCS	
			Percent Water (Volumetric)	CCS	

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Sump No. 5 Level Control	LE-05	Level Sensor	)	SUMP 5	
	LT-05	Level Transmitter	) Level Indication/Control	SUMP 5	Ultrasonic
	LIC-05	Indicating Controller	)	CCS	
	SY-05	Converter	Pump No. 5 Speed Control	CONT.R.	
Pump No. 5 Discharge Flow Measurement	FT-05	Flow Transmitter	Volumetric Flow Measurement	PIPE 5	Magmeter
				PIPE 5	
	FR-05P	Trend (Direct)	Volumetric Flow of Slurry	CCS	
	FQ-05P	Totalizer		CCS	
Pump No. 5 Discharge Stream Analysis	ME-05	Mass Flow Sensor	) Mass of Slurry Measurement	PIPE 5	
	MT-05	Mass Flow Transmitter	)	RACK 2	
	AE-05	Conductivity Sensor	) % Volume of Water Measurement	PIPE 5	
	AT-05	Conductivity Transmitter	)	RACK 1	
	MR-05P	Trend (Direct)	Mass Flow of Slurry	CCS	
	MQ-05P	Totalizer		CCS	
	SR-05P	Trend (Calculated)	Specific Gravity of Slurry	CCS	
	FR-05S	Trend (Calculated)	Volumetric Flow of Solids	CCS	
	FQ-05S	Totalizer		CCS	
	MR-05S	Trend (Calculated)	Mass Flow of Solids	CCS	
	MQ-05S	Totalizer		CCS	
	SR-05S	Trend (Calculated)	Specific Gravity of Solids	CCS	
	QR-05S	Trend (Calculated)	Percent Solids (Volumetric)	CCS	
	WR-05S	Trend (Calculated)	Percent Solids (by weight)	CCS	
	FR-05W	Trend (Calculated)	Volumetric Flow of Water	CCS	
	MR-05W	Trend (Calculated)	Mass Flow of Water	CCS	
	QR-05W	Trend (Direct)	Percent Water (Volumetric)	CCS	

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Conditioner No. 1 Level Control	LE-06	Level Sensor	)	SUMP 6	
	LT-06	Level Transmitter	) Level Indication/Control	SUMP 6	Ultrasonic
	LIC-06	Indicating Controller	)	CCS	
	LC-06	Valve Actuator/Controller		SUMP 6	
	LV-06	Control Valve	Water Addition	SUMP 6	Motorized
Pump No. 6 Discharge Flow Control	FT-06	Flow Transmitter	) Volumetric Flow	PIPE 6	Magmeter
	FIC-06	Indicating Controller	) Indication/Control	PIPE 6 CCS	
	FR-06P	Trend (Direct)	Volumetric Flow of Slurry		
	FQ-06P	Totalizer (Direct)		CCS	
	SY-06	Converter	Pump No. 6 Speed Control	CONT.R.	
Pump No. 6 Discharge Stream Analysis	ME-06	Mass Flow Sensor	) Mass of Slurry Measurement	PIPE 6	
	MT-06	Mass Flow Transmitter	)	RACK 2	
	AE-06	Conductivity Sensor	) % Volume of Water Measurement	PIPE 6	
	AT-06	Conductivity Transmitter	)	RACK 1	
	MR-06P	Trend (Direct)	Mass Flow of Slurry	CCS	
	MQ-06P	Totalizer		CCS	
	SR-06P	Trend (Calculated)	Specific Gravity of Slurry	CCS	
	FR-06S	Trend (Calculated)	Volumetric Flow of Solids	CCS	
	FQ-06S	Totalizer		CCS	
	MR-06S	Trend (Calculated)	Mass Flow of Solids	CCS	
	MQ-06S	Totalizer		CCS	
	SR-06S	Trend (Calculated)	Specific Gravity of Solids	CCS	
	QR-06S	Trend (Direct)	Percent Solids (Volumetric)	CCS	
	WR-06S	Trend (Calculated)	Percent Solids (by weight)	CCS	
	FR-06W	Trend (Calculated)	Volumetric Flow of Water	CCS	
	MR-06W	Trend (Calculated)	Mass Flow of Water	CCS	
	QR-06W	Trend (Calculated)	Percent Water (Volumetric)	CCS	

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Conditioner No. 2 Level Control	LE-07	Level Sensor	)	SUMP 7	
	LT-07	Level Transmitter	) Level Indication/Control	SUMP 7	Ultrasonic
	LIC-07	Indicating Controller		CCS	
	LC-07	Valve Actuator/Controller	)	SUMP 7	
	LV-07	Control Valve	) Water Addition	SUMP 7	Motorized
Pump No. 7 Discharge Flow Control	FT-07	Flow Transmitter	) Volumetric Flow	PIPE 7	Magmeter
	FIC-07	Indicating Controller	) Indication/Control	PIPE 7 CCS	
	FR-07P	Trend (Direct)	Volumetric Flow of Slurry	CCS	
	FQ-07P	Totalizer (Direct)		CCS	
	SY-07	Converter	Pump No. 7 Speed Control	CONT.R.	
Pump No. 7 Discharge Stream Analysis	ME-07	Mass Flow Sensor	) Mass of Slurry Measurement	PIPE 7	
	MT-07	Mass Flow Transmitter	)	RACK 2	
	AE-07	Conductivity Sensor	) % Volume of Water Measurement	PIPE 7	
	AT-07	Conductivity Transmitter	)	RACK 1	
	MR-07P	Trend (Direct)	Mass Flow of Slurry	CCS	
	MQ-07P	Totalizer		CCS	
	SR-07P	Trend (Calculated)	Specific Gravity of Slurry	CCS	
	FR-07S	Trend (Calculated)	Volumetric Flow of Solids	CCS	
	FQ-07S	Totalizer		CCS	
	MR-07S	Trend (Calculated)	Mass Flow of Solids	CCS	
	MQ-07S	Totalizer		CCS	
	SR-07S	Trend (Calculated)	Specific Gravity of Solids	CCS	
	QR-07S	Trend (Calculated)	Percent Solids (Volumetric)	CCS	
	WR-07S	Trend (Calculated)	Percent Solids (by weight)	CCS	
	FR-07W	Trend (Calculated)	Volumetric Flow of Water	CCS	
	MR-07W	Trend (Calculated)	Mass Flow of Water	CCS	
	QR-07W	Trend (Direct)	Percent Water (Volumetric)	CCS	

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SERVICE	TAG NO.	DESCRIPTION	CONTROL SYSTEM FUNCTION	LOCATION	REMARKS
Water Tank	LE-08	Level Sensor	Level Indication/Controller	W TANK	Ultrasonic
	LT-08	Level Transmitter		W TANK	
Level Control	LIC-08	Indicating Controller		CS	
	LC-08	Valve Actuator/Controller		W TANK	
	LV-05	Control Valve	Make-Up Water	W TANK	Motorized
Water Tank Make-Up Flow	FT-09	Flow Transmitter	Volumetric Flow Measurement	PIPE 19	Magmeter
	FR-09	Trend		PIPE 19 CCS	
Dewatering Unit Discharge Flow	FT-10	Flow Transmitter	Volumetric Flow Measurement	PIPE 16	
	FR-10	Trend		PIPE 16 CCS	

9.4 System Start-Up Check List

The computer program will feature a system start-up check list for each process option. The operator will be required to complete this list in order to ensure that the process option selected for testing physically exits on the trailer and also to set the operating flow parameters.

These check lists are contained herein.

PROCESS OPTION 1

	Questions	Input
1.	Is raw feed pipe connected to Sump 1 and valve closed?	Y N
2.	Is Pump 2 discharge connected to sizing screen?	Y N
3.	Is Pump 7 discharge connected to Bank 2 cells?	Y N
4.	Is Froth Pump 1 connected to filter?	Y N
5.	Is Froth Pump 2 connected to filter?	Y N
6.	Is filtrate pump discharge connected to Sump 5?	Y N
7.	Is fresh water pipe connected to water tank?	Y N
8.	Which make of cells Bank 1?	Wemco/Denver
9.	Which type of cells Bank 2?	DR/Sub A
10.	What flow rate Pump 1, 2 and 6 (all same)	?m^3/h
11.	What flow rate Pump 7?	?m^3/h
12.	Is Conditioner 1 to be used as conditioner or sump?	Conditioner/ Sump
13.	If conditioner, is Valve 8 closed? If conditioner, is Valve 9 open?	Y N Y N
14.	If sump, is Valve 8 open? If sump, is Valve 9 closed?	Y N Y N
15.	Is Conditioner 2 to be used as conditioner or sump?	Conditioner/ Sump
16.	If conditioner, is Valve 10 closed? If conditioner, is Valve 11 open?	Y N Y N
17.	If sump, is Valve 10 open? If sump, is Valve 11 closed?	Y N Y N
18.	Is underflow from deslime screen routed to Sump 2?	Y N
19.	Is underflow from sizing screen routed to Conditioner 1?	Y N
20.	Is tailings from Bank 1 cells routed to Sump 5?	Y N

21. Which froth reagent pumps are to run:

1.	Y	N
2.	Y	N
3.	Y	N
4.	Y	N
5.	Y	N
6.	Y	N
7.	Y	N
8.	Y	N
9.	Y	N
10.	Y	N
11.	Y	N
12.	Y	N
13.	Y	N

22. Pump 5 Discharge:

Is Valve 1 closed?	Y	N
Is Valve 2 open?	Y	N

23. Is tailings from cell Bank 2 routed to Sump 5? Y N

24. Are screen hold-down clamps released Y N

PROCESS OPTION 2

	Questions	Input
1.	Is raw feed pipe connected to Sump 1 and valve closed?	Y N
2.	Is desliming screen underflow routed to Conditioner 1?	Y N
3.	Is Pump 2 discharge connected to sizing screen?	Y N
4.	Is Pump 7 discharge connected to Bank 2 cells?	Y N
5.	Is sizing screen underflow routed to Sump 5?	Y N
6.	Is Bank 1 cells tailing routed to Sump 2?	Y N
7.	Is Froth Pump 1 connected to filter?	Y N
8.	If Froth Pump 2 connected to filter?	Y N
9.	Is filtrate pump connected to Sump 5?	Y N
10.	Is fresh water pipe connected to water tank?	Y N
11.	Which make of cells Bank 1?	Wemco/Denver
12.	Which type of cells Bank 2?	DR/Sub A
13.	What flow rate Pump 1, 2 and 6 (all same)?	?m^3/h
14.	What flow rate Pump 7?	?m^3/h
15.	Is Conditioner 1 to be used as conditioner or sump?	Conditioner/ Sump
	If conditioner, is Valve 8 closed?	Y N
	If conditioner, is Valve 9 open?	Y N
	If sump, is Valve 8 open?	Y N
	If sump, is Valve 9 closed?	Y N

16. Which froth reagent pumps are to run:

1.	Y	N
2.	Y	N
3.	Y	N
4.	Y	N
5.	Y	N
6.	Y	N
7.	Y	N
8.	Y	N
9.	Y	N
10.	Y	N
11.	Y	N
12.	Y	N
13.	Y	N

17. Are screen hold-down clamps released? Y N

PROCESS OPTION 3

	Questions	Input
1.	Is raw feed pipe connected to Sump 1 and valve closed?	Y N
2.	Is desliming screen underflow routed to Conditioner 1?	Y N
3.	Are valves on Pump 5 discharge set to recirculate on water tank?	Y N
4.	Is Bank 1 tailings routed to Sump 5?	Y N
5.	Is froth pump discharge connected to filter?	Y N
6.	Is filtrate pump discharge connected to Sump 5?	Y N
7.	Is fresh water pipe connected to water tank?	Y N
8.	Is Conditioner 1 to be used as conditioner or sump?	Conditoner/ Sump
	If conditioner, is Valve 8 closed?	Y N
	If conditioner, is Valve 9 open?	Y N
	If sump, is Valve 8 open?	Y N
	If sump, is Valve 9 closed?	Y N
9.	What flow rate Pump 1 and 6 (both same)	?m^3/h
10.	What make of cells Bank 1?	Wemco/Denver
11.	Which froth reagent pumps are to run:	
	1.	Y N
	3.	Y N
	5.	Y N
	6.	Y N
	7.	Y N
12.	Are screen hold-down clamps released?	Y N

PROCESS OPTION 4

	Questions	Input
1.	Is raw feed pipe connected to Sump 1 and valve closed?	Y N
2.	Is Pump 2 discharge connected to sizing screen?	Y N
3.	Is Pump 3 discharge connected to dewatering screen?	Y N
4.	Is Pump 4 discharge connected to Sump 5?	Y N
5.	Are valves on Pump 5 discharge set to recirculate on water tank?	Y N
6.	Is Pump 7 discharge connected to Reichert Spiral?	Y N
7.	Is desliming screen underflow routed to Sump 2?	Y N
8.	Is sizing screen underflow routed to Conditioner 1?	Y N
9.	Is cells Bank 1 tailings routed to Sump 5?	Y N
10.	Is Froth Pump 1 discharge connected to filter?	Y N
11.	Is filtrate pump discharge routed to Sump 5?	Y N
12.	Is dewatering screen underflow routed to Sump 5?	Y N
13.	What flow rate Pumps 1, 2, 6 (all same)?	?m^3/h
14.	What flow rate Pump 7?	?m^3/h
15.	What flow rate Pump 3?	?m^3/h
16.	What flow rate Pump 4?	?m^3/h
17.	Is Conditioner 1 to be used as conditioner or sump?	Conditioner/ Sump
	If conditioner, is Valve 8 closed?	Y N
	If conditioner, is Valve 9 open?	Y N
	If sump, is Valve 8 open?	Y N
	If sump, is Valve 9 closed?	Y N
18.	Conditioner 2 will be used as sump:	Conditioner/ Sump
	Is Valve 10 open?	Y N
	Is Valve 11 closed?	Y N
19.	What make of cells Bank 1	Wemco/Denver?

20. Only one start of the Reichert Spiral need to be used. Isolate one start. Y N

21. Which froth reagent pumps are to run:

1.	Y	N
3.	Y	N
5.	Y	N
6.	Y	N
7.	Y	N

22. Are screen hold-down clamps released? Y N

PROCESS OPTION 5

	Questions	Input
1.	Is Pump 2 discharge routed to sizing screen?	Y N
2.	Is Pump 3 discharge routed to dewatering screen?	Y N
3.	Is Pump 4 discharge routed to desliming screen?	Y N
4.	Is Pump 7 discharge routed to Reichert Spiral?	Y N
5.	Is desliming screen underflow routed to Sump 5?	Y N
6.	Is sizing screen underflow routed to Conditioner 1?	Y N
7.	Is cells Bank 1 tailings routed to Sump 5?	Y N
8.	Is Froth Pump 1 discharge routed to filter?	Y N
9.	Is filtrate pump discharge routed to Sump 5?	Y N
10.	Is dewatering screen underflow routed to Sump 5?	Y N
11.	Is raw feed pipe routed to Sump 2 and valve closed?	Y N
12.	Is fresh water pipe connected to water tank?	Y N
13.	What flow rate Pumps 2 and 6 (both same)?	Y N
14.	What flow rate Pump 7?	?m^3/N
15.	What flow rate Pump 3?	?m^3/N
16.	What flow rate Pump 4?	?m^3/N
17.	What make cells Bank 1?	Wemco/Denver
18.	Is Conditioner 1 to be used as a conditioner or sump?	Conditioner/ Sump
	If conditioner, is Valve 8 closed?	Y N
	If conditioner, is Valve 9 open?	Y N
	If sump, is Valve 8 open?	Y N
	If sump, is Valve 9 closed?	Y N
19.	Conditioner 2 will be used as a sump:	Conditioner/ Sump
	Is Valve 10 open?	Y N
	Is Valve 11 closed?	Y N

20. Only one start of the Reichert Spiral need be used. Isolate one start. Y N

21. Which froth reagent pumps are to run:

1.	Y	N
3.	Y	N
5.	Y	N
6.	Y	N
7.	Y	N

22. Are screen hold-down clamps released? Y N

PROCESS OPTION 6

	Questions	Input
1.	Is Pump 2 discharge routed to Reichert Spiral?	Y N
2.	Is Pump 3 discharge routed to sizing screen?	Y N
3.	Is Pump 4 discharge routed to Sump 5?	Y N
4.	Is Pump 7 discharge routed to dewatering screen?	Y N
5.	Is desliming screen underflow routed to Sump 2?	Y N
6.	Is sizing screen underflow routed to Conditioner 1?	Y N
7.	Is cells Bank 1 tailings routed to Sump 5?	Y N
8.	Is Froth Pump 1 discharge routed to filter?	Y N
9.	Is filtrate pump discharge routed to Sump 5?	Y N
10.	Is fresh water pipe connected to water tank?	Y N
11.	Are valves on Pump 5 discharge set to circulate on water tank?	Y N
12.	Is raw feed routed to Sump 1 and valve closed?	Y N
13.	What flow rate Pumps 1, 2 and 6 (all same)?	?m^3/h
14.	What flow rate Pump 3?	?m^3/h
15.	What flow rate Pump 4?	?m^3/h
16.	What flow rate Pump 7?	?m^3/h
17.	What make of cells Bank 1?	Wemco/Denver
18.	Is Conditioner 1 to be used as conditioner or sump?	Conditioner/ Sump
	If conditioner, is Valve 8 closed?	Y N
	If conditioner, is Valve 9 open?	Y N
	If sump, is Valve 8 open?	Y N
	If sump, is Valve 9 closed?	Y N
19.	Conditioner 2 will be used as sump:	Conditoner/ Sump
	Is Valve 10 open?	Y N
	Is Valve 11 closed?	Y N

20. Both starts of Reichert Spiral should be used. Ensure feed to both. Y N

21. What froth reagent pumps are to run:

1.	Y	N
3.	Y	N
5.	Y	N
6.	Y	N
7.	Y	N

22. Are screen hold-down clamps released? Y N

PROCESS OPTION 7

	Questions	Input
1.	Is Pump 2 discharge routed to sizing screen?	Y N
2.	Is Pump 3 discharge routed to dewatering screen?	Y N
3.	Is Pump 4 discharge routed to Sump 5?	Y N
4.	Is Pump 7 discharge routed to Reichert Spiral?	Y N
5.	Only one start of the Reichert Spiral need be used. Isolate one start.	Y N
6.	Is desliming screen underflow routed to Sump 2?	Y N
7.	Is sizing screen underflow routed to Sump 5?	Y N
8.	Is fresh water pipe connected to water tank?	Y N
9.	Is dewatering screen underflow routed to Sump 5?	Y N
10.	Is raw feed routed to Sump 1 and valve closed?	Y N
11.	What flow rate Pumps 1 and 2 (both same)?	?m^3/h
12.	What flow rate Pump 3?	?m^3/h
13.	What flow rate Pump 4?	?m^3/h
14.	What flow rate Pump 7?	?m^3/h
15.	Conditioner 2 will be used as a sump:	
	Is Valve 10 open?	Y N
	Is Valve 11 closed?	Y N
16.	Are valves on Pump 5 discharge set to recirculate on water tank?	Y N
17.	Are screen hold-down clamps released?	Y N

9.5 List of Drawings

Drawing No.		Title	Rev
42022-I-01		Central Control System Panel Layout	0
42022-I-02		Instrument Racks Layout	0
42022-I-03	Sh. 1	Level Loop Diagram (Type 1)	0
	Sh. 2	Level Loop Diagram (Type 2)	0
	Sh. 3	Flow Loop Diagram (Type 1)	0
	Sh. 4	Flow Loop Diagram (Type 2)	0
	Sh. 5	Flow Loop Diagram (Type 3)	0
	Sh. 6	Conductivity Loop Diagram (Type 1)	0
	Sh. 7	Mass Flow Loop Diagram (Type 1)	0
42022-I-11		Sequence Logic Diagram - Process Option 1.	0
42022-I-12		Sequence Logic Diagram - Process Option 2.	0
42022-I-13		Sequence Logic Diagram - Process Option 3.	0
42022-I-14		Sequence Logic Diagram - Process Option 4.	0
42022-I-15		Sequence Logic Diagram - Process Option 5.	0
42022-I-16		Sequence Logic Diagram - Process Option 6.	0
42022-I-17		Sequence Logic Diagram - Process Option 7.	0
42022-I-18		Logic Block Diagram Legend.	0
42022-I-19		Process Option 1 Logic Diagram.	0

42022-I-20	Process Option 2 Logic Diagram.	0
42022-I-21	Process Option 3 Logic Diagram.	0
42022-I-22	Process Option 4 Logic Diagram.	0
42022-I-23	Process Option 5 Logic Diagram.	0
42022-I-24	Process Option 6 Logic Diagram.	0
42022-I-25	Process Option 7 Logic Diagram.	0

9.6 Manufacturer's Information

Contained herein are copies of the manufacturer's data sheets for the items of instrumentation included in our design.

MILLTRONICS

PROCESS CONTROLS FOR INDUSTRY

SPECIFICATION SHEET 620

level measuring systems

MicroRanger

* Optional LCD meter shown

NON-CONTACTING LEVEL MEASUREMENT FOR THE PRICE OF A MECHANICAL SYSTEM

MicroRanger

Milltronics is the world leader in the design and manufacture of Ultrasonic Level Measuring Systems. Our development of non-contacting level devices over the past 15 years has resulted in worldwide acceptance with more than 11,000 points in operation.

In a continuing effort to provide industry with the best continuous level measuring systems Milltronics proudly introduces the MICRORANGER.

This short range system (2-12 ft.) will accurately determine the level of any solid, liquid, slurry or syrup . . . acid to alkaline . . . in any type of hopper, vat or tank.

The Milltronics MICRORANGER provides this unique flexibility at a price that is very competitive with conventional contacting devices . . . yet offers so much more.

EASE OF INSTALLATION AND START-UP

The **MICRORANGER** can be installed and operating in as little as 10 minutes. Field adjustments are limited to zero and span. Recalibration is never required. The **MICRORANGER** automatically adjusts to any process changes eliminating repetitive operator adjustments.

SAVES TIME AND MONEY

The **MICRORANGER'S** non-contacting design assures zero maintenance and maximum reliability.

PATENTED ULTRASON™ TRANSDUCER

The **MICRORANGER'S** sensing element is the patented Ultrason™ Transducer Model ST25B having no moving parts.

The Ultrason™ transducers most unique feature is its self-cleaning action which assures maintenance free operation in dusty environments.

In harsh chemical applications, e.g. acids, the transducer will be supplied with optional teflon or P.V.C. facing providing ultimate protection in any environment.

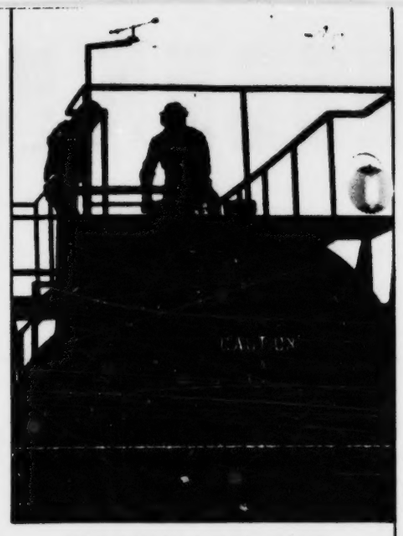
The Ultrason™ transducer has hazardous area approval for Class I, A, B, C and D and Class II F and G.

TEMPERATURE COMPENSATION

The built-in temperature compensation circuitry assures precise level indication or control over an extended temperature range by simply attaching the optional temperature sensor.

ANALOG OUTPUT

The **MICRORANGER** provides three true current outputs 4-20 mA or 0-20 mA, stab selectable, for remote level indication or control and 0-1 mA for local meter indication.



8 ft. application, Hydrofluoric acid

ALARM SET POINTS

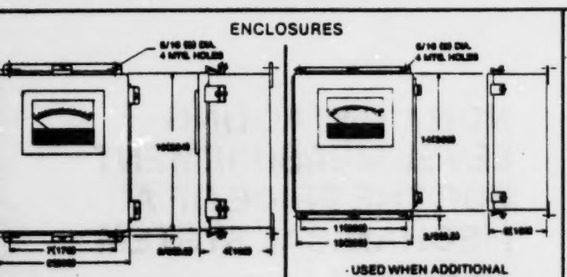
Hi-low alarm contacts, up to six, are available as an option via our unique satellite alarm modules.

NOTE: The large Nema 4 enclosure is required when satellite alarms are used.

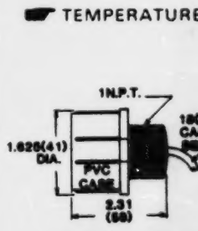
SPECIFICATIONS

RANGE:	2 to 12 Ft. (.6 to 3.6 m) or 2 to 6 Ft. (.6 to 1.8 m)
SPAN:	6 in. to 10 Ft. (150 mm to 3 m)
ACCURACY:	System accuracy better than 0.5% of span.
OUTPUT:	4-20 mA into Max. 750 ohms, OR 0-20 mA into Max. 750 ohms, Stab Selectable. 0-1 mA for local analog meter.
OUTPUT DAMPING:	Standard, continuously adjustable.
BLANKING:	Continuously adjustable from 2 Ft. (.6 m) to 6 Ft. (1.8 m)
FAIL SAFE:	Stab selectable for high or low output.
TRARSDUCER:	Barium Titanate element C.P.V.C. outer housing and polyurethane radiating face. Optional face materials are available.
SEPARATION:	Maximum distance from transducer to electronics is 183 m (600 Ft.) using RG-62U co-axial cable.
METERS; OPTIONAL:	Analog 0-100% Digital LCD 0-100%
ALARMS; OPTIONAL:	Satellite alarm modules, to a maximum of 3 providing a total of 6 alarm points.
PUMP CONTROL; OPTIONAL:	Pump Control Modules provide start-stop control for up to six pumps. Each pump control/alarm point has two Form "C" Contacts (1 D.P.D.T.) rated 10 Amps 115 V.A.C. non-inductive L.E.D. status indicator.
TEMPERATURE COMPENSATION:	Optional temperature sensor holds output variation to within 0.01% per degree C.
TEMPERATURE RANGE:	Electronics -20°C to +60°C (-5 to +140°F) Transducer -40°C to +93°C (-40 to +200°F)
POWER REQUIRED:	105-135V 50/60 Hz 210-270V 50/60 Hz Line voltage must be specified when ordering to ensure proper transformer selection.
BURDEN:	15VA
ENCLOSURE:	Nema 4 standard 10" x 8" x 4" (254 x 203 x 102) Larger enclosure required when satellite alarms utilized.
WEIGHT:	Transducer 2 lbs. (.9 kg) Enclosure and Electronics 12 lbs. (5 kg)

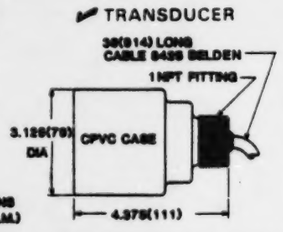
ENCLOSURES



TEMPERATURE SENSOR



TRANSDUCER



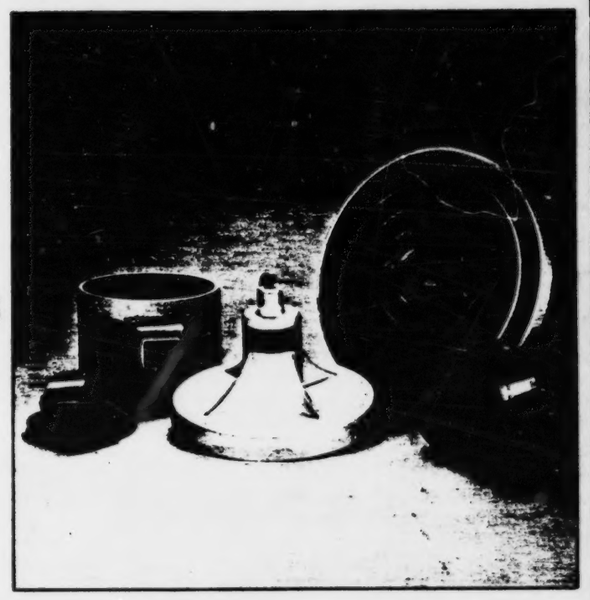
CSA Certified Class I Groups A, B, C and D; Class II Groups F and G.
FM Approved Class 2 Div. 1 Groups E, F and G.

Milltronics

Ultrasonic Level Measuring Systems

Ultrasonic Transducers

- ☐ Innovative patented design
- ☐ Highest efficiency available
- ☐ Reliable from 2 to 200 feet (0.6 - 61 m)
- ☐ Non-contacting
- ☐ Self-cleaning
- ☐ Totally enclosed - no moving parts
- ☐ Maintenance-free
- ☐ Immune to dusty, steamy, turbulent environments
- ☐ Approved for hazardous locations



Purpose

Non-contacting ultrasonic transducers are the most efficient and reliable way to determine a level of material in depths from 4 inches to 200 feet (10 cm - 61 m). Because of their patented design, Milltronics' transducers operate effectively on solids, liquids, slurries and resins with absolute reliability. These cost-effective devices are the most powerful and efficient transducers available; and even in dusty, steamy, corrosive environments they are self-cleaning and maintenance-free. All Milltronics transducers are approved for use in hazardous areas. For especially hostile environments, they can be faced with protective material and flange mounted to assure continuous service.

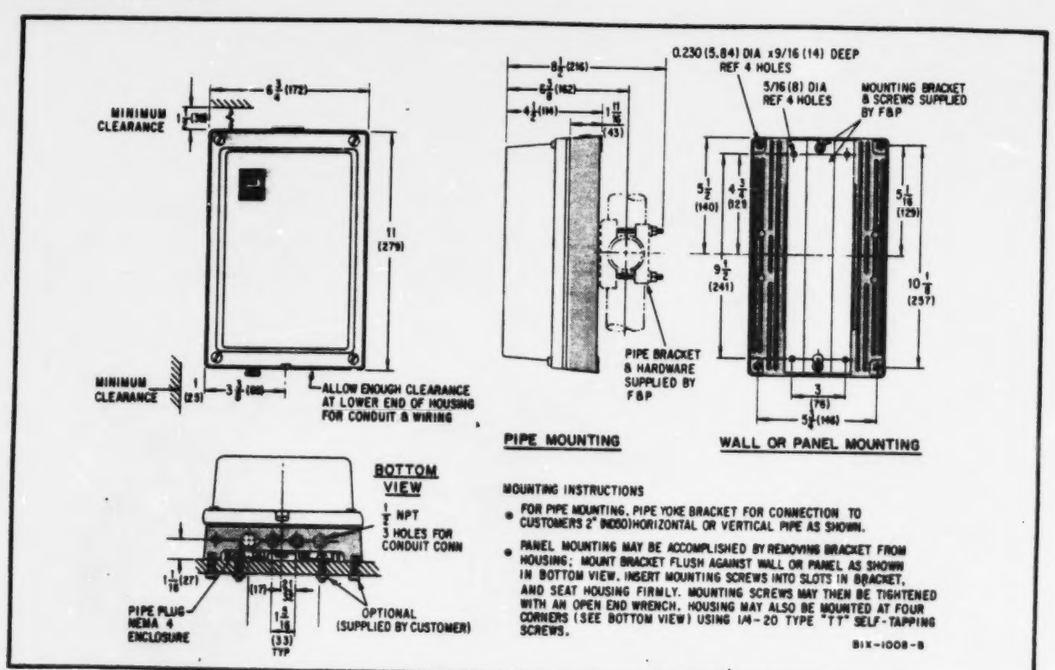
How It Works

The non-contacting, solid state transducer fires a high frequency ultrasonic pulse in a narrow beam toward the material to be measured, and receives the reflected echo. The two way transit time is converted electronically to provide an analog output proportional to the distance between the transducer and the material being measured. The efficiency of the sonic pulse is a crucial factor in providing reliable measurement. The Ultrason ST series crystal array transducer maximizes its sonic pulse with an impedance matching design, which provides up to 54x more power than conventional transducers. These transducers provide outstanding reliability from a span of 4 inches to 100 feet (10 cm - 30.5 m). For power that will handle the 200 ft. (61 m) range, we have developed the most technologically advanced transducer yet, the flexural mode (FM). The FM series transducer has a unique construction which ensures a high ratio of return-to transmit signal - up to 400x more than conventional transducers. This unmatched operating efficiency enables the ST and FM series transducers to operate without troublesome reflector cones, or external pre-amplifiers. Consequently, they cost less and are easy to install.

Specification sheet [illegible]
rev. [illegible]

MILLTRONICS

FISCHER & PORTER



MOUNTING INSTRUCTIONS

- FOR PIPE MOUNTING, PIPE YOKE BRACKET FOR CONNECTION TO CUSTOMERS 2" (NOS) HORIZONTAL OR VERTICAL PIPE AS SHOWN.
- PANEL MOUNTING MAY BE ACCOMPLISHED BY REMOVING BRACKET FROM HOUSING; MOUNT BRACKET FLUSH AGAINST WALL OR PANEL AS SHOWN IN BOTTOM VIEW. INSERT MOUNTING SCREWS INTO SLOTS IN BRACKET, AND SEAT HOUSING FIRMLY. MOUNTING SCREWS MAY THEN BE TIGHTENED WITH AN OPEN END WRENCH. HOUSING MAY ALSO BE MOUNTED AT FOUR CORNERS (SEE BOTTOM VIEW) USING 1/4-20 TYPE "TT" SELF-TAPPING SCREWS.

BIX-1008-B

FIGURE 2. OUTLINE DIMENSIONS OF REMOTE MOUNTED SIGNAL CONVERTER

Model Number 10D1475 C

miniMAG	
Design Level	
Flowmeter Size	
2.5 mm (1/10")	B
4 mm (5/32")	C
6 mm (1/4")	D
10 mm (3/8")	E
15 mm (1/2")	F
25 mm (1")	G
40 mm (1 1/2")	H
50 mm (2")	J
80 mm (3")	K
100 mm (4")	L
Used with Flange (Type and Class)	
ANSI 150	B
ANSI 300	C
BS10 Table D	D
BS10 Table E	E
BS10 Table F	F
DIN PN10	G
DIN PN16	H
DIN PN25	J
DIN PN40	K
Converter Location	
Integral to Flowmeter	C
Remote; Pipe or Surface Mounting	E
Power	
120 V ac; 50/60 Hz	1
220/240 V ac; 50/60 Hz	2
12 V dc	3
24 V dc	4

Continued	B B
Output	T
4-20 mA dc	1
0-20 mA dc	3
0-1 kHz	5
Mounting Hardware	
Bolts, Nuts, etc.	B
Safety Classification	B
Electrode, Carbide with	
Tantalum	B
Zirconium	C

ORDERING INFORMATION

Specify Model 10D1475C and flowmeter size (usually) same as pipe size).
Type and class of flange being used.
Integral or remote mounting converter.
Power source.
Output signal and maximum flow rate.
Liquid or slurry (by name, concentration, and operating temperature and pressure.
Environment temperature (maximum) and hazard classification.

Note: Specifications are subject to change without notice.

Pub. 23362e

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Printed in U.S.A. January 1984
184 LL 8M

FISCHER & PORTER COMPANY
Warminster, Pennsylvania 18974
Phone: (215) 674-6000

Direct Mass Flow Measurement Product Catalog

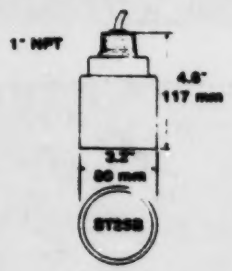
MICRO® MOTION

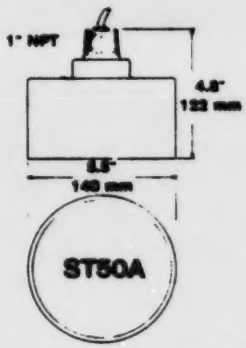
MICRO® MOTION

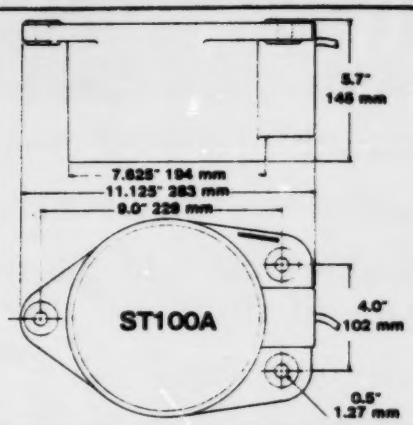
May 1984

ST series Ultrason™ - Impedance Matched Efficiency

Mounting Dimensions







Principle of Operation

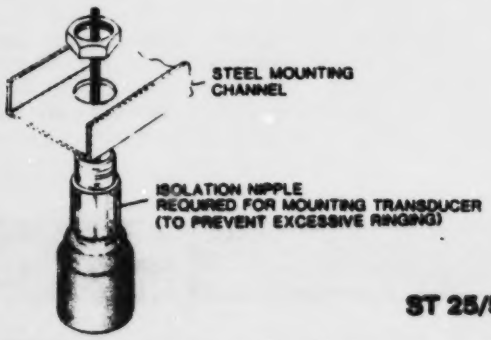
The "workhorse" of transducers - the Ultrason ST series transducers are acoustically impedance matched by a patented process proprietary to Milltronics. They have a large diameter piezoelectric barium titanate crystal which is electrically and mechanically resonant at the operating frequency. For applications where increased power levels are necessary, transducers with multiple crystal arrays are used.

Polyurethane facings for wet environments, and an impedance matching polyethelene foam facing for dry applications are standard features - this has resulted in their continuous use, over a wide range of industries, since 1965.

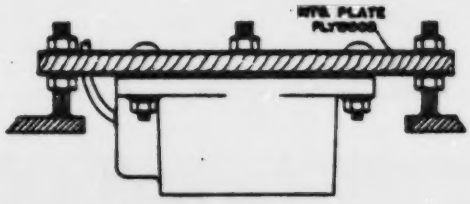
Operating Advantages

1. Acoustic impedance matching results in amplitude returns 54x greater than ordinary transducers for guaranteed reliability.
2. They operate over a wide temperature range.
3. The radiating surface is self-cleaning in all environments.
4. Construction of the ST Series provides ruggedness for the worst industrial applications, clean lines for sanitary service in food processing, and adaptability for corrosive environments and outdoor applications.
5. A variety of facing materials extends the use of the ST series in a wide range of corrosive applications. Vinyl, Teflon, and Kynar are some of the facings which have provided effective service.

Mounting: ST Series



ST 25/50



ST 100

Approvals

CSA & FM approved for use with respective Milltronics transceivers/scanners for:

CSA	- Class I, Div. I, Gr. A, B, C, D Class II, Div. I, Gr. F & G	BASEEFA	- Standard Number SFA 3009:1972 Class Exs II, T6
FM	- Class I, Div. I, Gr. D, A, B, C, D Class II, Div. I, Gr. E, F, G		

Condensed approval listings. Consult approval guide, or factory for complete listings.

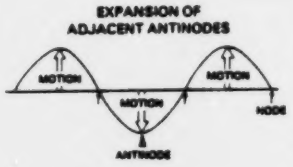
In North America, Milltronics provides a full engineering service to recommend the correct match of transducer and application. In addition, we provide both a performance and an equipment guarantee.

Flexural Mode Ultrason™ - Long Range Efficiency

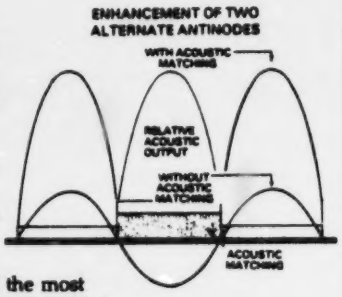
Principle of Operation

1. The diagram shows a disc cross section vibrating.

2. An expanded section of the disc shows adjacent antinodes. Note the out of phase motion which effectively cancels the sound wave and would result in a sonic pulse of little strength.



3. To produce an intense sonic pulse we increase the radiation efficiency of the LR transducer by applying multiple layers of impedance-matching material to the disc face in a precisely determined pattern. Developed by, and patented solely to Milltronics, this technique results in the production of the most efficient sonic wave yet possible. This is the basis of the LR series transducers' unmatched superiority in determining levels up to 200 feet (61 m).



Operating Advantages

The patented LR series flexural mode transducers provide maximum acoustic coupling to assure superior operation. They perform with one standard face on either solids or liquids, even in harsh environments.

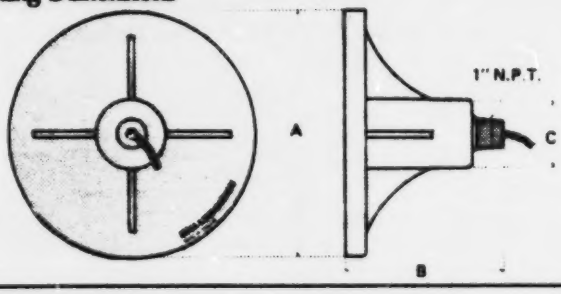
1. **High Efficiency** — Comparison tests show the transmit/receive figures of the Flexural Mode Transducers to be 14 to 400 times higher than conventional units.
2. **Narrow Beam Width** — Typically 5.5° or better at -3db for maximum concentration of Ultrasonic Energy.
3. **Sidelobes** — Unwanted off-axis transmissions are suppressed by a very effective -19db.
4. **Small Deadband** — The more efficient coupling to the air path results in a shorter ring down and therefore provides a shorter minimum range of 3 ft. (0.9 m)
5. **Maximum Range** — Low frequency operation achieves ranges up to 200 ft. (61 m)
6. **Not Affected by Dust Build-up** — Milltronics' exclusive Sonic Self Cleaning Action provides reliable no-maintenance operation to high dust areas.
7. **Immune** — To the detrimental effects of steam and moisture.
8. **High in Performance** — Small in size and cost.

How efficient are flexural mode transducers?

COMPARATIVE DATA*	FLEXURAL MODE	CRYSTAL ARRAY	REFLECTOR
MODEL NO.	LR-13-FM	ST100AP	TYPICAL
Echo Strength from Target at 7.5 ft. (2.2 m)	14.0V	1.05V	0.02V
Frequency	13 kHz	21 kHz	14.4 kHz
Beam Width (-3db)	5.5°	6.7°	6°
Sidelobes	-19db	-18db	-11.8db
Minimum Range	4 ft. (1.2 m)	4 ft. (1.2 m)	6.6 ft (2.0 m)
Maximum Range	200 ft. (61 m)	100 ft. (30.5 m)	100 ft. (30.5 m)
Manufacturer	Milltronics	Milltronics	Brand "X"

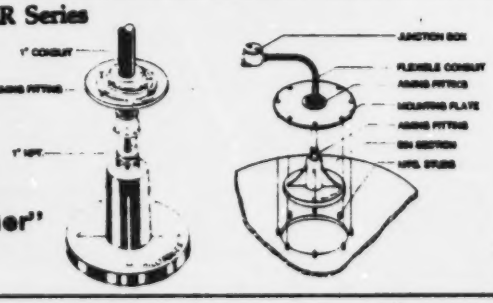
*Figures shown are results of single unit testing.

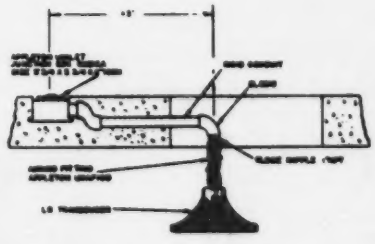
Mounting Dimensions



	LR-13-FM	LR-21-FM
"A"	14 in. - 356 mm	10.5 in. - 267 mm
"B"	9.0 in. - 230 mm	7.0 in. - 178 mm
"C"	3.0 in. - 76 mm	3.0 in. - 76 mm

Mounting: LR Series





Approvals

CSA & FM approved for use with respective Milltronics transceivers/scanners for:

CSA	- Class I, Div. I, Gr. D (Methane) Class II, Div. I, Gr. E, F, G	SAA	- Class I, Zone 0
FM	- Class I, Div. I, Gr. D (Methane) Class II, Div. I, Gr. E, F, G	SAA-DIP	- Class II, Div. I & II
BASEEFA	- Standard Number SFA 3009:1972 - Class Exs II, T6		

Condensed approval listings. Consult approval guide, or factory for complete listings.

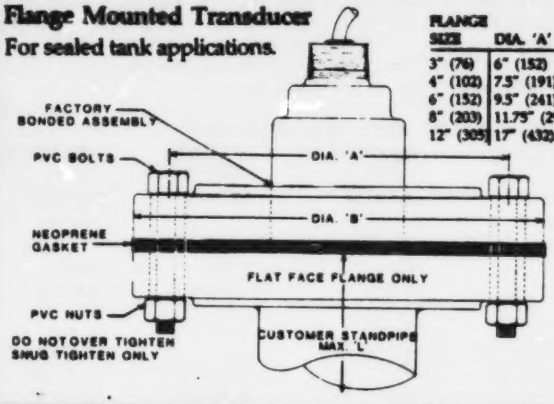
Special Applications: Ultrason™ Transducers

The Easy Aimer

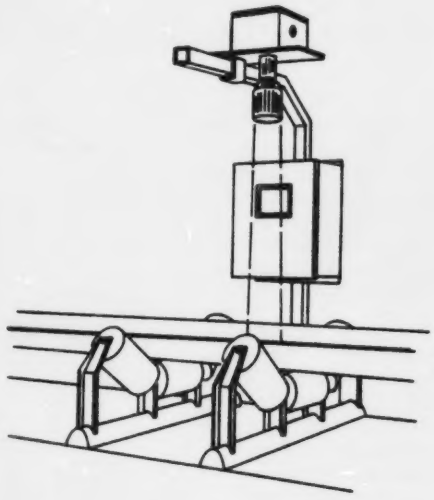
This is a strongly recommended option for all ST and LR series transducers on solids applications. It facilitates siting of the transducer, compensating both for the location of the transducer, and for the many possible angles of repose of the material.

Flange Mounted Transducer

For sealed tank applications.



FLANGE SIZE	DIA. 'A'	DIA. 'B'	MAX. 'L'
3" (76)	6" (152)	7.5" (191)	12" 305 mm
4" (102)	7.5" (191)	9" (229)	12" 305 mm
6" (152)	9.5" (241)	11" (279)	14" 356 mm
8" (203)	11.75" (298)	13.5" (343)	16" 406 mm
12" (305)	17" (432)	19" (483)	24" 610 mm

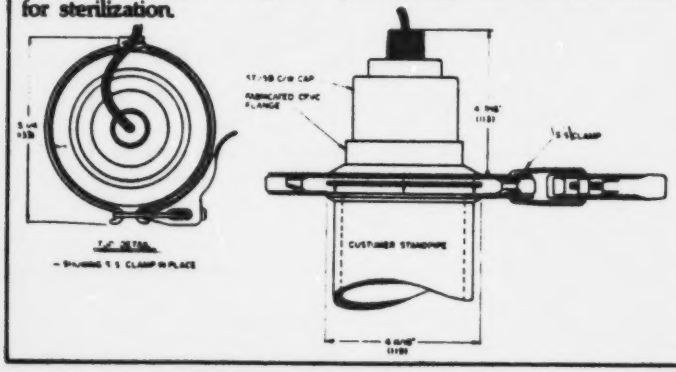


Belt Mount

This universal mounting arrangement fits all conveyors and eliminates the need for custom mounting arrangements.

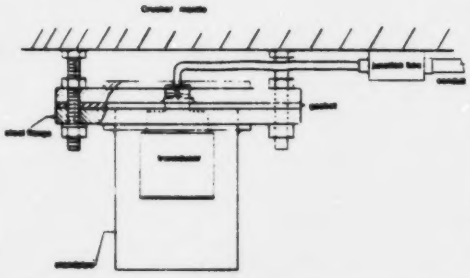
Sanitary Flange

The sanitary flange is designed to provide easy removal of the transducer for sterilization.



Gyratory Crusher Mount

A protective mounting for use in areas where the transducer may be damaged by falling debris.



Technical Specifications

Model No.	Measuring Range	Frequency	Beam Angle	Temp.	Housing	Flanges	Facings
ST25	2-25 ft. 0.6-7.6 m	41.5 kHz	12°	-40 to 200°F -40 to 93°C	C.P.V.C.	3, 4, 6, 8, 10"	P, T, V*
ST50	3-50 ft. 0.9-15.2 m	41.5 kHz	5°	-40 to 200°F -40 to 93°C	C.P.V.C.	6, 8, 10"	P, T, V*
ST100	4-100 ft. 1.2-30.5 m	21 kHz	7°	-40 to 170°F -40 to 77°C	Alum.	custom	P*
LR21	3-100 ft. 0.9-30.5 m	21 kHz	5°	-40 to 170°F -40 to 77°C	Alum.	-	P/S*
LR13	4-200 ft. 1.2-61 m	13 kHz	5.5°	-40 to 170°F -40 to 77°C	Alum.	-	P/S*

*P - Polyethylene foam for dusty application *T - Teflon - Corrosive chemicals *V - Chlorinated Poly Vinyl - Corrosive chemicals *S - Styrofoam

Specifications Subject to Change Without Notice

MILLTRONICS

TELEPHONE
(705) 745-2431
(403) 276-9109
(514) 337-0141
(817) 277-3543

BOX 4420, 730 THE KINGSWAY, PETERBOROUGH, ONTARIO CANADA K9J 7B1
13632 DEER RUN BLVD. S.E., CALGARY, ALBERTA T2J 6P1
SUITE 305, 7575 TRANS CANADA HWY., ST. LAURENT, QUEBEC H4T 1V6
709 STADIUM DRIVE EAST, ARLINGTON, TEXAS 76011

TELEX 06-962851
TELEX 730312

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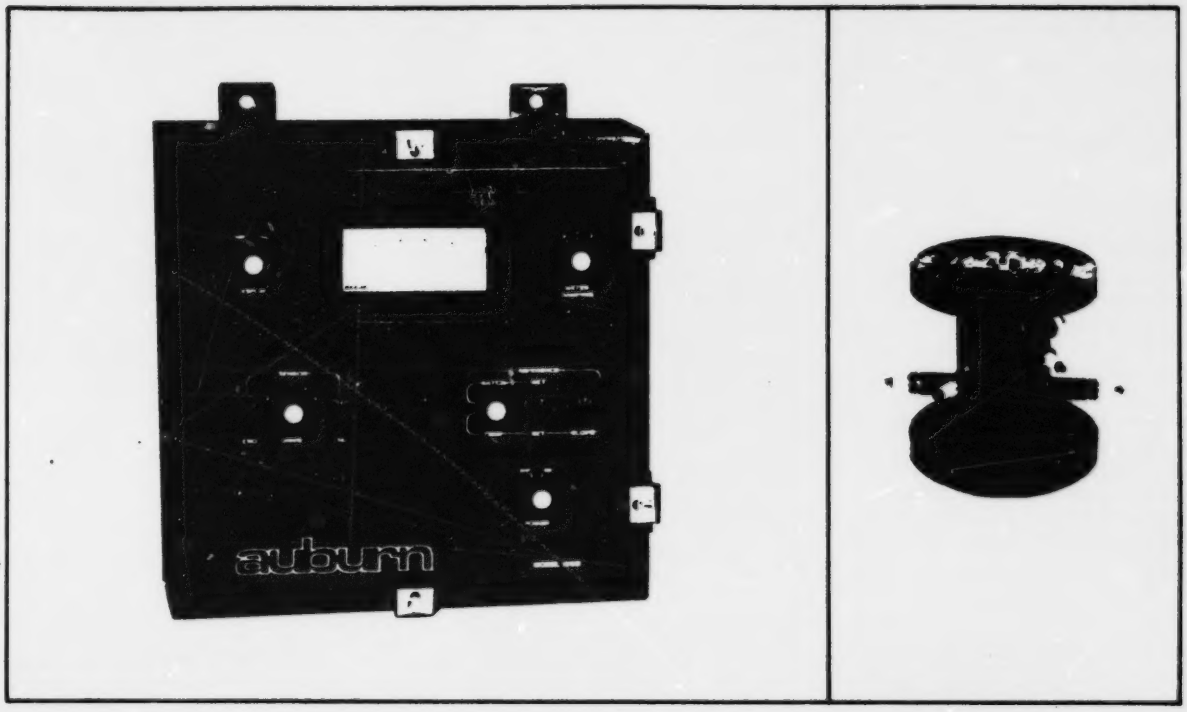
auburn INTERNATIONAL
Slurry Monitor

Model 1080*



The Auburn Model 1080 is a process control instrument designed to measure solid or gas content of a two-phase flow when the liquid medium is conductive. The unique, patented rotating-field technique employed in this instrument assures accurate real-time measurement.

APPLICATIONS

- **Rubber Crumb/Water Slurry**
- **Alumina in Caustic Slurry**
- **Polymers in Water**
- **Fertilizer Slurry**
- **Air/Water and Steam/Water Flows**
- **Other Gas/Water and Solids/Water Applications**

FEATURES

- **Patented Field-Rotation Technique** . . . **assures accurate measurement in both horizontal and vertical pipes**
- **Real-Time Measurement** . . . . . **provides continuous on-line measurement**
- **Built-In Diagnostics** . . . . . **allows simple test of system integrity**
- **Signal Isolation** . . . . . **prevents electrical interference from outside sources**
- **Reference Channel** . . . . . **automatic compensation for temperature and ionic concentration variation**
- **Non-Intrusive** . . . . . **no pressure drop or flow disturbance**
- **Mass Flow Measurement** . . . . . **the companion Model 1082 Mass Flow Monitor couples the 1080 measurement with a velocity measurement to indicate mass flow**

*Patented

Auburn International, Inc., One Southside Road, Danvers, Massachusetts 01923 (617) 777-2460 TWX: 710-347-1770

auburn INTERNATIONAL

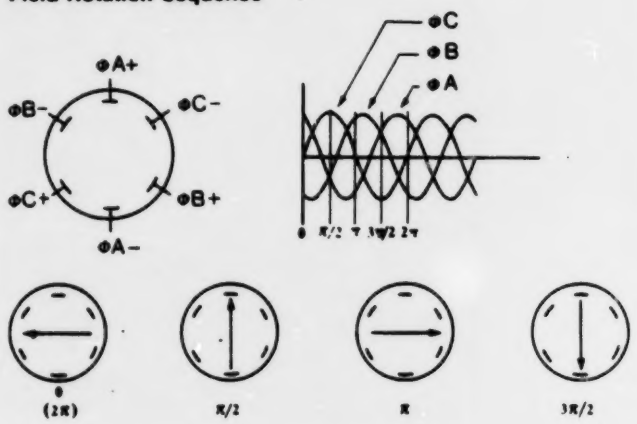
Description

The Auburn Model 1080 employs a patented field rotation sensing technique for accurate measurement of solid (or gas) content in conductive two-phase flows. The unit consists of a main sensor spool piece, an integral reference sensor, and an electronics unit. The instrument design offers continuous real-time observation of the relative volumetric content of two-component flows in which the liquid transport medium is conductive.

Field Rotation Sensing Technique

The field rotation technique provides accurate, uniform measurement on a continuous basis. The rotating field allows real-time measurement of the complete sensor cross-section and renders the measurement independent of pipeline attitude (horizontal or vertical). As shown, the rotation of the field is accomplished by the placement of six electrodes around the inner circumference of the sensor. Opposed pairs are excited by 5 kHz voltages, each 120° apart. The field rotates at 5000RPS. No mechanical rotation occurs.

Field Rotation Sequence



Principle of Operation

The Model 1080 operates by measuring the electrical conductivity of the flowing media within a sensor spool piece. It is required that the liquid phase be conductive while the solid (or gas) phase be of significantly lower conductivity. The conductivity of the liquid phase may change due to temperature and ion concentration variation. Therefore, a reference conductivity measurement is made to normalize variations of the bulk conductivity.

Specifications:

Power:	120V, 60Hz (220V optional)
Electrode Excitation:	0-8 VPP at 5kHz
Signal Output:	1-10V (4-20 ma optional)
Max. Liquid Conductivity:	400k μS/cm

Options:

- Mass Flow . . . by incorporating a velocity measurement, the mass flow of either component can be determined.
- Signal Averaging . . . averages fluctuations of solid (or gas) content over time.
- Hazardous Locations . . . explosion-proof enclosures available.

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APPLICATION DATA SHEET

auburn

MODEL: Model 1080 Two-Phase Flow Monitor

INDUSTRY: Water Slurries or Gas/Water Flow Lines

AREA of USE: Process Loop

PROBLEM: Need for reliable, accurate means to monitor two-phase flow conditions.

The Model 1080 is employed to measure the liquid versus solid or gas fraction in a two-phase flow involving a conductive medium. The measurement is accomplished by making an average conductivity measurement of the stream. The solids or gas form non-conductive voids in the stream, thus reducing the average conductivity of the stream in direct proportion to their volume fraction.

Typical applications for the Model 1080 include the:

a.) determination of the solids loading of slurries such as plastic pellets, rubber crumb, or fertilizer solids in water.

b.) determination of the gas content in a stream, which occurs during heat transfer and vortex formation studies, as well as certain processes.

If two electrodes are placed on opposite sides of a pipe, the electric field is concentrated between the electrodes and does not uniformly measure the entire cross-section. Thus, a gas bubble or solid affects the conductivity measured between the electrodes differently, dependent upon its location in the cross-section of the stream. To overcome this limitation, the Model 1080 employs a sensor with six electrodes (three pairs) spaced around the circumference of the stream cross-section. Opposed pairs of electrodes are connected through conductance measuring circuits which pass a low level 5KHz AC current through the stream. The three pairs of electrodes are excited electrically 120° apart, thus forming a three-phase rotating electric field within the stream cross-section. (Refer to the Model 1080 data sheet for a field rotation diagram.) It should be noted that all electrodes are active during the entire rotation of the field; thus, the vector, shown rotating within the sensor, represents the total field within the sensor and <u>not a simple point-to-point measurement</u>.

The three measurement circuits are connected in a "star" arrangement to correctly transfer the measurement from the sensor to the circuitry. The output of each circuit is rectified and summed to produce a signal

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which is proportional to the average conductivity of the stream within the main sensor.

The conducitivity of the liquid phase, usually water, will vary with ion content and temperature. (If the liquid phase is non-conductive liquid, remember that it can be measured by the Model 1090.)

To remove the effect of conductivity changes, a separate, two electrode reference conductivity measurement of the liquid phase only is made to generate a signal proportional to the liquid conductivity. The average conductivity signal derived from the main stream sensor is divided by the reference conductivity signal to produce an output equal to the liquid fraction (%L) within the main stream sensor.

It is, therefore, important to sample a single-phase liquid stream from some convenient location in the same flow, to permit compensation for liquid conductivity variations.

Internal Electrical Information

1.	Input Power	=	105-125V, 50-60 Hz, 1Ø @ 1A maximum
2.	Sensor Excitation Voltages	=	4 volt RMS maximum, typically ≈ 1V @ 5KHz
3.	Standard Analog Outputs	=	0-10 VDC @ 1mA maximum load
4.	Power Supply Rail Voltages	=	+15 and -15 VDC

Front Panel

1. Front panel display: 0-100 µA analog meter.
2. Front panel controls:
   a. ON-OFF switch
   b. Display switch, %L, and REFERENCE
   c. ZERO, DRIVE, and CAL for the reference sensor
   d. ZERO, DRIVE, and CAL for the main sensor
   e. Meter damping, 0, 1, and 2 seconds.
3. Internally mounted controls:
   a. Test switch RUN, ØA only, ØB only, and ØC only.
      (Used to check for proper main sensor connection and operation.)

Options Available

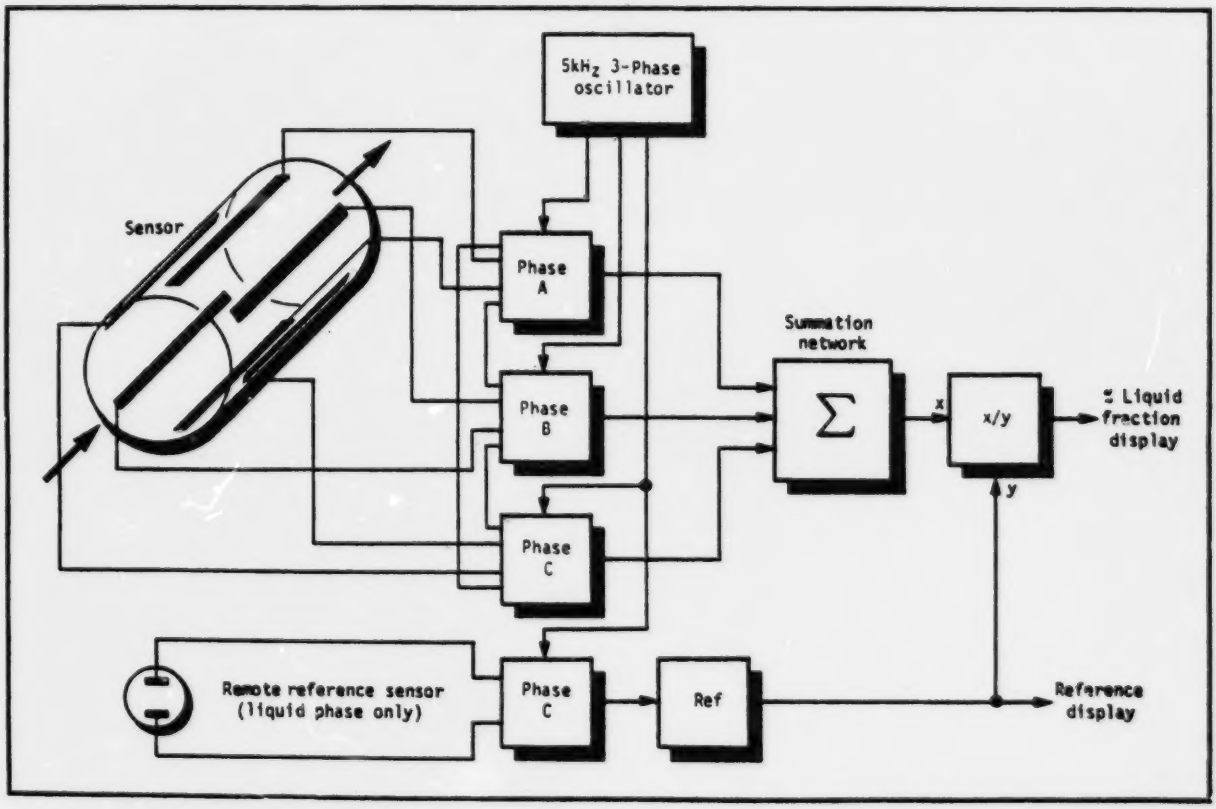
1. % void, wherein %L is subtracted from one.
2. Scale expansion of either or both %L and %V. (The maximum amount of expansion available is determined by the application.)
3. 4-20 mA output.*
4. Isolated 4-20 mA output.*
5. Rack-mount/bench top enclosure for laboratory or control room applications.
6. Very high conductivity applications require that a special configuration of the instrument be employed where the measurement loop circuitry is mounted close to the sensors.
7. Made-up cables, to 100 feet. (Very low conductivity applications may require limited length.)

*Standard output 0-10 VDC

Basic Information Required for Application of the Model 1080

1. The approximate liquid conductivity range usually in micro-Mhos (micro-Siemens) per cm. (If not available, get sample.)
   The Model 1080 can be operated over a conductivity range from 50 µS/cm to 400,000 µS/cm. However, several steps in measurement circuit component values are required to handle the entire range. Thus, the instrument is set-up for the particular application range.
2. Solids must have low conductivity relative to the liquid. (If not known, get sample.)
3. % solids or gas (by volume) to be measured.
4. Main Sensor:
   a. Line size
   b. Temperature range
   c. Pressure range
   d. Are the solids abrasive?
   e. Horizontal or vertical line
   f. Any pertinent information regarding the installation.

   Sensors are designed in several configurations dependent upon the parameters stated above.
5. Reference sensor location.

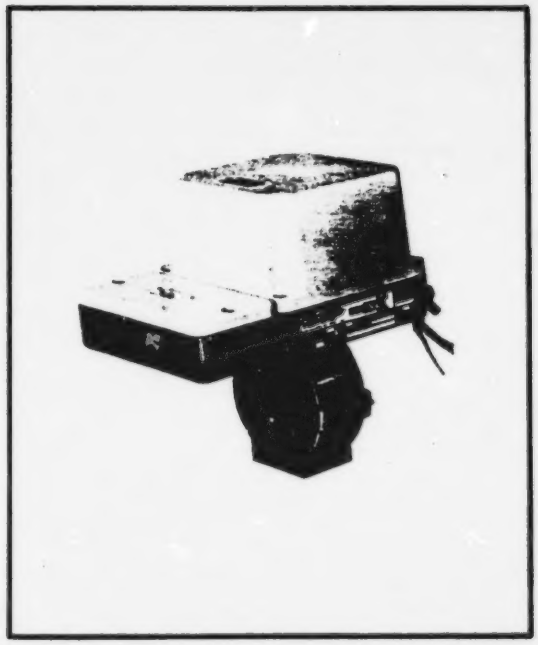


FISCHER & PORTER

SPECIFICATION

mini MAG® Magnetic Flowmeter

Model 10D1475



The Fischer & Porter Model 10D1475 Magnetic Flowmeter is a *MAG-X*® (pulsed dc) type volumetric, liquid flow rate detector. It utilizes, as the process transducing method, the characteristic of a conductive liquid to generate an induced voltage when flowing through a magnetic field. The amplitude of the voltage, thus produced, is directly proportional to the flow rate of the metered liquid. A characterized non-uniform magnetic field design significantly reduces sensitivity to flow profile effects as compared with magnetic flowmeters having uniform magnetic fields.

The meter's magnet coils are powered by a magnet driver unit. This unique method of magnet coil drive, as utilized in the Series 10D1475, provides total zero point stability. The output signal from the electronics package can be either 4-20 mA dc analog or 0-1 kHz frequency. The electronics package can be mounted on the magnetic flowmeter or remote from it. All circuit components are of solid state design, conservatively rated and carefully selected to assure maximum reliability and life expectancy.

DESIGN FEATURES

- Wafer design body mounts between ANSI Class 150 or 300 flanges, DIN flanges or BS flanges.
- Absolute zero stability - No zero adjustment. Eliminates requirement for shutoff valves upstream and downstream of the miniMag flowmeter for zero alignment.
- High accuracy. - Ensures optimum production control and significantly reduces possibility of process waste.
- Extremely low power consumption. - Reduces energy costs.
- Handles liquids with conductivities down to 5 microsiemens per centimeter (μS/cm). Consult factory for lower conductivities.
- Linear and accurate flow rate measurement. Characterized nonhomogeneous magnetic field assures a voltage output equal to continuous average flow velocity.
- Only 3 diameters straight upstream pipe run to the electrode axis required for normal piping configuration such as a single elbow.
- No pressure loss when meter tube and pipe diameter are equal. - Reduces pump size and saves energy.
- Electronics are completely interchangeable without regard to size and without calibration.
- Volumetric flow rate measurement independent of fluid viscosity, density and temperature.
- Isolation of output from input circuit.
- High impedance device - input impedance to signal converter is 10^{12} ohms or greater.
- Separate customer connection box isolates electronics compartment and protects electronics from the environment.
- Internal calibrator uses self test function to confirm proper operation of electronics.
- Internal zero return circuit provides positive zero output signal from external dry contact.

ENGINEERING SPECIFICATIONS

Minimum Liquid Conductivity: 5 μS/cm.

Electrical Power Requirements: 120 V ac, ±10%, 50/60 Hz. ± 5%

Optional Power: 220 V ac, ±10%, 50/60 Hz. ±5% or 240 V ac ±10%, 50/60 Hz. ± 5% (Not available for U.S. Customers). 12-16 V dc or 20-28 V dc.

Power Consumption: Less than 15W (15VA).

Pressure Limits: Up to 5.1 MPa (740 psig) at +40°C (+100°F).

Vacuum Limits: Full Vacuum at +40°C (+100°F).

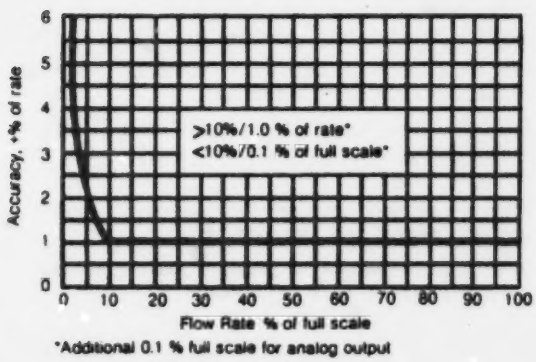
Temperature Limits:

Process Liquid: 120°C (250°F) Maximum.
Ambient: -40 to +65°C (-40 to +150°F)

NOTE: Electronics must be mounted remote from the magmeter when the temperature at the electronics exceeds 65°C (150°F). The table below shows combinations of process and ambient temperatures that will cause the temperature at the electronics to reach 65°C (150°F).

AMBIENT TEMPERATURE		PROCESS TEMPERATURE	
°C	°F	°C	°F
21	70	121	250
27	80	113	235
35	95	102	215
41	105	93	200
49	120	82	180

SYSTEM ACCURACY: Valid for any range setting between minimum and maximum ranges shown in Table 1. For optimum performance, meter should be sized so that maximum flows fall between 10 and 50% of maximum range values. Flows for coating processes such as sludge should be kept above 5 feet per second. Abrasive slurries should flow at 6 to 8 feet per second.



*Additional 0.1 % full scale for analog output

Repeatability: 0.1% fsc

Rangeability: 100:1 (Process signal is cut-off when flow rate falls below 1% of full scale.

Span: Factory set for full scale output signal as specified between minimum and maximum ranges shown in Table 1. Can be changed in the field by simple screwdriver adjustment.

Meter Size		Minimum Range		Maximum Range	
		0-3.3 ft/s Flow Velocity	0-1.0 m/s Flow Velocity	0-33 ft/s Flow Velocity	0-10 m/s Flow Velocity
inch	mm	gpm	L/min	gpm	L/min
1/10	2.5	0.08	0.3	0.8	3
5/32	4	0.2	0.7	2	7
1/4	6	0.5	1.9	5	19
3/8	10	1.2	4.5	12	45
1/2	15	2.5	9.5	25	95
1	25	8	30	80	300
1-1/2	40	20	76	200	760
2	50	30	114	300	1140
3	80	70	265	700	2650
4	100	120	455	1200	4550

TABLE 1

Ambient Temperature Effect: Less than 0.15% full scale per 10°C (18°F) Temperature change.

Output: Analog or Frequency. Analog current is 4 to 20 mA dc or 0 to 20 mA dc into 0-900 Ω load.

Frequency: 0-1 kHz square wave into a minimum of 150 Ω and a max of 700 Ω (5V P-P) Symmetrical at all frequencies.

Isolation: Input and output signals are fully isolated.

Signal Cut-off: Output signal will drop to 0% when the input signal drops below 1% of the full scale setting.

Radio Frequency Interference Protection: Equivalent to SAMA Class 2 - abc - 0.1% (10 V/m - 20 to 1000 MHz) supplied as standard.

Zero Return: Provides constant zero output signal during empty pipe and other conditions when false flow signals are possible. Integral to electronics and activated by external non-powered contact.

Smoothing: Full scale response time can be varied from 4 seconds (standard) to 95 seconds, by jumper selection of capacitor values in 3 steps.

Internal Calibration Check: Verify calibration with simple built in signal injection.

Enclosure Classification: NEMA 4 (IEC 529 IP65) suitable for indoor or outdoor installation Optional IEC 529 IP67 occasional submergence in water up to 10 meters (33 feet) for up to 48 hours.

Safety Classification: 120 V ac, 12 V dc +24 V dc.
FM Approved: Non Incendive for Cl. I, Div. 2, Gr. A, B, C & D.Dust Ignition Proof Cl. II, Div. 1, Gr. E, F & G. Suitable for Cl. III, Div. 1 Outdoor Hazardous Locations.

Materials of Construction:

Liner: Tefzel*
Electrode: Tungsten Carbide tip with either Tantalum or Zirconium holder.
Meter Tube: Type 304 Stainless Steel
Housing: Electonics: Die Cast Aluminum
Flowmeter: Welded Cast Steel.

Outline & Mounting Dimensions: See Figures 1 & 2.

Electrical Connections: 1/2 Inch NPT

Paint: Epoxy.

*DUPONT FLUOROPOLYMER RESIN

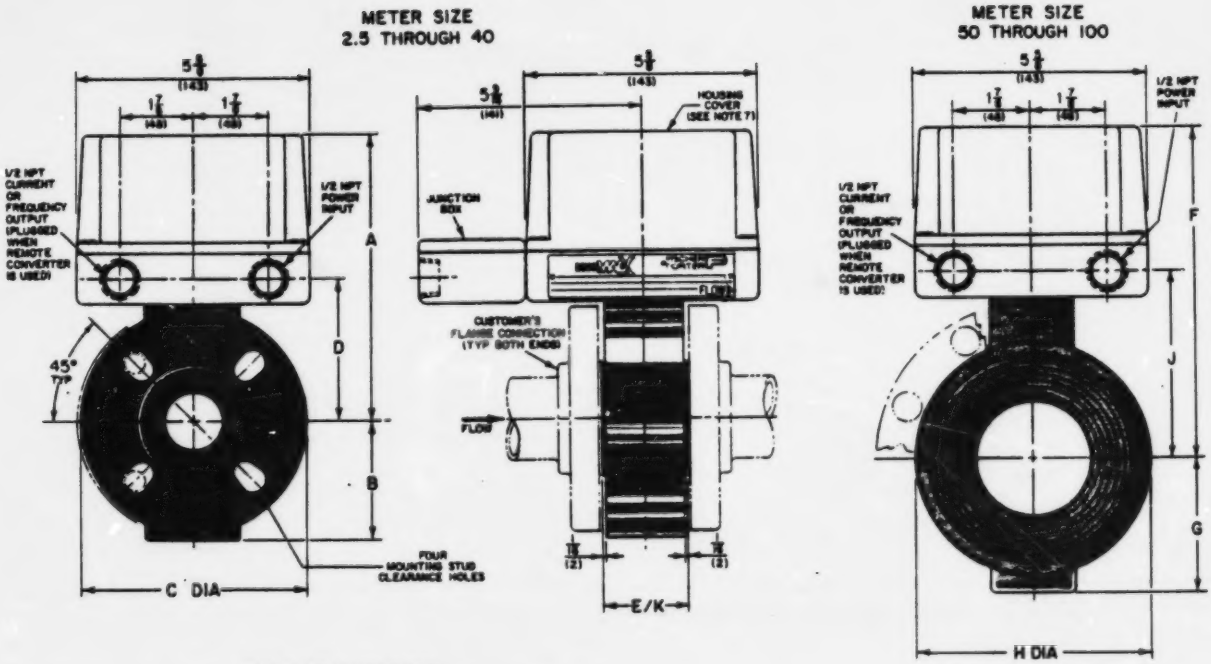


TABLE OF DIMENSIONS

METER SIZE		FLANGE SIZE		CUSTOMER FLANGE TYPE AND RATING	A		B		C DIA		D		E	
INCH	mm	IN.	mm		INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm
1/10	2.5	1/2	15	ANSI 150 ANSI 300 BS 10 TBL D,E,F DIN PN 10, 16, 25 & 40	6 1/4	159	2 1/32	52	3 3/4	95	2 3/8	60	2 3/32	55
5/32	4													
1/4	6													
3/8	10													
1/2	15	↓	↓	↓										
1	25	1	25		6 13/16	173	2 29/32	66	4 7/8	124	3 1/8	79	2 9/32	55
1 1/2	40	1 1/2	40		7 1/2	191	3 5/32	83	6 1/8	156	3 11/16	97	2 3/4	70

METER AND FLANGE SIZES		CUSTOMER FLANGE TYPE AND RATING	F		G		H DIA		J		K	
INCH	mm		INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm
2	50	ANSI 150 ANSI 300 BS 10 TBL D,E,F DIN PN 10, 16, 25 & 40	8	203	2 7/16	62	3 7/8	98	4 3/16	110	3 11/16	95
3	80		8 11/16	221	3 9/16	91	5 1/8	130	4 11/16	126	4 23/32	120
4	100		9 3/8	238	3 11/16	94	6 3/8	168	5 11/16	144	5 23/32	150

NOTES

1. DIMENSIONS ARE IN INCHES AND MILLIMETERS (mm).
2. DIMENSIONS PROVIDED FOR REFERENCE ONLY.
3. ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCE OF ± 1/8 INCH (3mm).
4. METER MUST BE COMPLETELY FILLED WITH LIQUID TO ENSURE ACCURACY.
5. FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW. 1/2 NPT CONDUIT CONNECTION IN METER HOUSING IDENTIFIES "UPSTREAM" FLANGE FACE.
6. METER MOUNTS BETWEEN CUSTOMER'S PIPELINE FLANGES, TYPES AND RATINGS LISTED IN TABLE OF DIMENSIONS.
7. CLEARANCE REQUIRED TO REMOVE COVER IS 5 IN. (127).

SE 3430

FIGURE 1. OUTLINE DIMENSIONS

Model D Mass Flow Meters

MICRO® MOTION

Model D meters measure mass flow rate of liquids, gases and slurries — simply and directly. Direct method of measurement provides accurate, reliable mass flow data independent of changes in fluid temperature, pressure, density or viscosity. Remote electronics unit can be located up to 500 ft. from the hermetically sealed sensor unit.

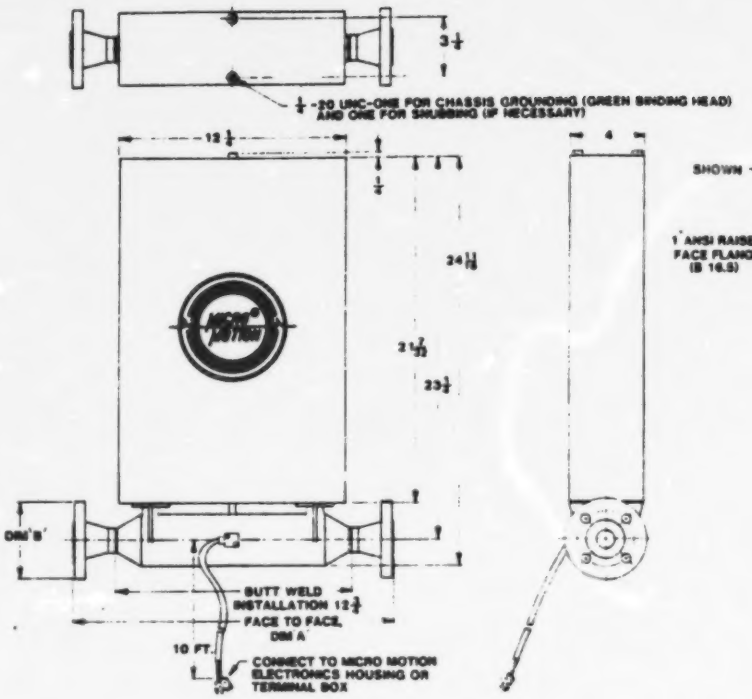
Standard Specifications

Accuracy	±0.4% of rate ± zero stability
Operating Temperature	−400°F to 400°F (−240°C to 200°C)
Electronics Temperature	−40°F to 150°F (−40°C to 65°C)
Wetted Parts	316L stainless steel
Output Signals	
Analog:	0-20 or 4-20 mA, 500 ohm max. load 0-50 or 10-50 mA, 250 ohm max. load 0-5, 1-5, 0-10 or 2-10 VDC, 100k ohm minimum input.
Frequency:	Max. output adjustable from 1.5-10,000 Hz. Solid state switch, 30 VDC, 1 amp max.
Response Time	Adjustable from 0.1 to 1.1 seconds
Power Requirements	100, 115, 220 VAC ± 10%, 12-30 VDC ±15%, 8 watts.

Detail Specifications

Specification	*Pressure Rating**	*Wetted Material*	*Units*	*Sensor Size*							
				6	*12*	*25*	*40*	*100*	*150*	*300*	*600*
Flow Range	S	SS	lbs/minute kgs/minute	0-2.4 0-1.1	0-14 0-6.4	0-60 0-36	0-120 0-55	0-1000 0-455	0-2800 0-1270	0-7000 0-3180	0-20,000 0-9090
	H	SS	lbs/minute kgs/minute		0-28 0-12	0-120 0-55	0-300 0-140				
Minimum Full Scale Flow	S	SS	lbs/minute kgs/minute	.12 .05	.70 .32	4.0 1.8	6.0 2.7	50 23	140 64	350 159	1000 455
	H	SS	lbs/minute kgs/minute		1.4 .64	6.0 2.7	15 6.8				
Rated Operating Pressure	S	SS	psi bars	2800 193	3000 207	2800 193	1250 86	2250 155	1500 103	600 41	800 55
	H	SS	psi bars		4000 276	4000 276	2800 193				

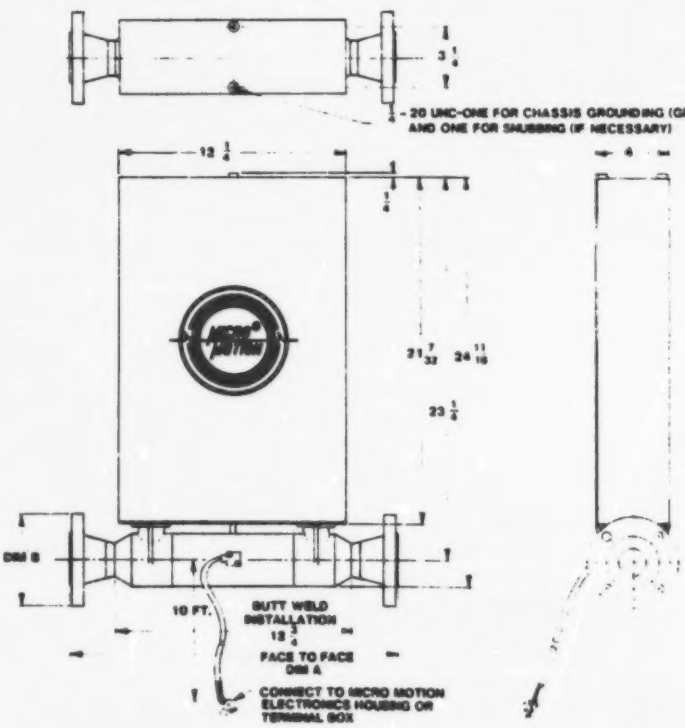
*Commensurate with proper fittings. Higher pressure ratings available.



FITTING	DIM A	DIM B
150 LB	17 1/8	4 1/4
300 LB	17 3/8	4 1/8
400 LB	18 1/8	4 1/8
600 LB	18 1/8	4 3/8
900 LB	19	5 3/8
1" PIPE (IPS) LADISH	13 1/4	2
1" GRAYLOC (1 GR11)	18 1/4	2
1" NPTM	18 1/2	1 7/8

SHOWN — 1" ANSI RAISED FACE FLANGE (B 16.5)

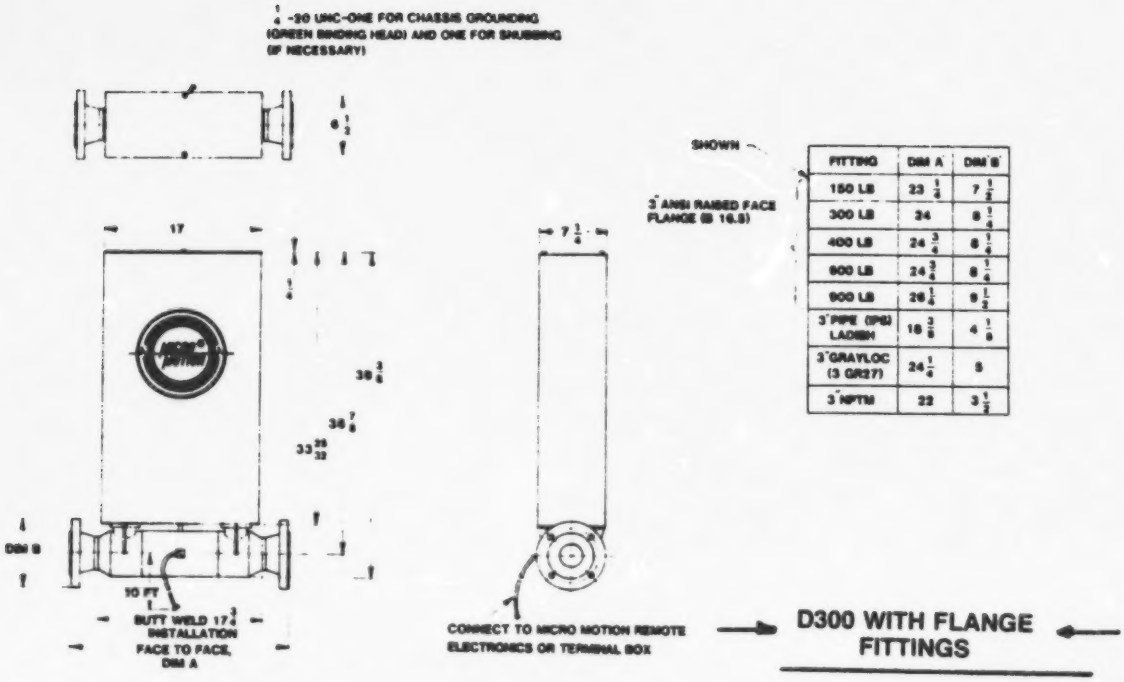
D100 WITH FLANGE FITTINGS



FITTING	DIM A	DIM B
150 LB	17 5/8	5
300 LB	18 1/8	6 1/8
400 LB	18 3/4	6 1/8
600 LB	18 3/4	6 1/8
900 LB	19 3/4	7
1 1/2" PIPE (IPS) LADISH	13 1/4	2 1/8
1 1/2" GRAYLOC (1 1/2 GR14)	17 1/2	3 1/16
1 1/2" NPTM	15 3/4	1 29/32

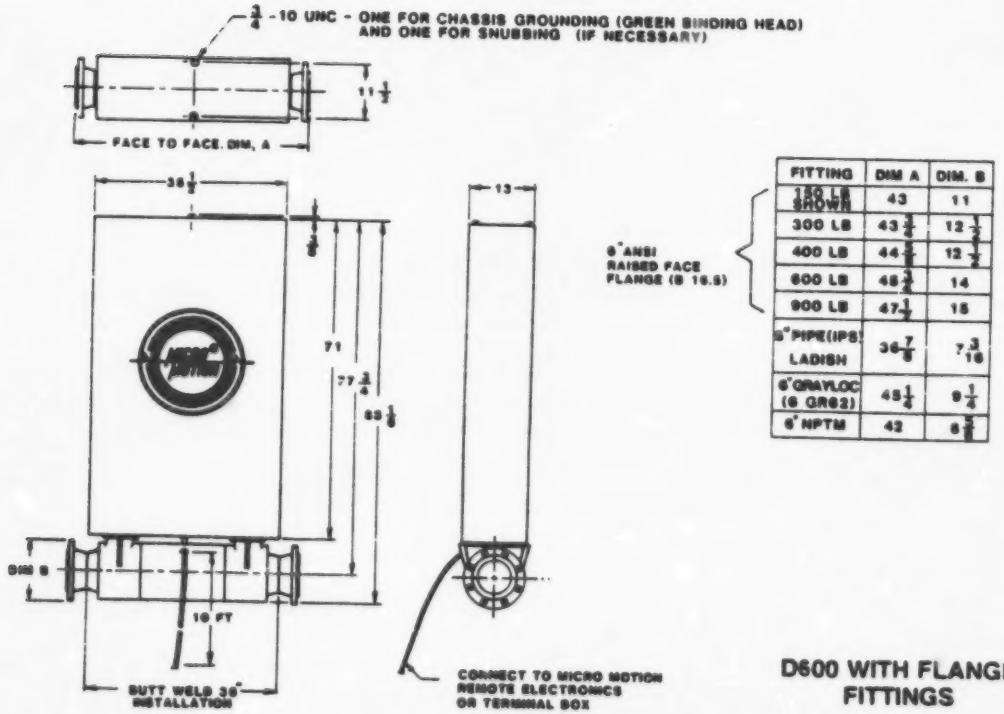
SHOWN — 1" 1/2 ANSI RAISED FACE FLANGE (B 16.5)

D150 WITH FLANGE FITTINGS


1/4 -20 UNC-ONE FOR CHASSIS GROUNDING (GREEN BINDING HEAD) AND ONE FOR SNUBBING (IF NECESSARY)
SHOWN
3" ANSI RAISED FACE FLANGE (B 16.5)
17
7 1/4
DIM B
10 FT
BUTT WELD 17 3/4 INSTALLATION FACE TO FACE, DIM A
CONNECT TO MICRO MOTION REMOTE ELECTRONICS OR TERMINAL BOX

FITTING	DIM A	DIM B
150 LB	23 1/4	7 1/2
300 LB	24	8 1/4
400 LB	24 3/4	8 1/4
600 LB	24 3/4	8 1/4
900 LB	26 1/4	9 1/2
3" PIPE (IPS) LADISH	18 3/8	4 1/8
3" GRAYLOC (3 GR27)	24 1/4	8
3" NPTM	22	3 1/2

D300 WITH FLANGE FITTINGS


3/4 -10 UNC - ONE FOR CHASSIS GROUNDING (GREEN BINDING HEAD) AND ONE FOR SNUBBING (IF NECESSARY)
11 1/2
FACE TO FACE, DIM. A
36 1/2
13
71
77 3/4
85 1/8
DIM B
10 FT
BUTT WELD 36" INSTALLATION
CONNECT TO MICRO MOTION REMOTE ELECTRONICS OR TERMINAL BOX

FITTING	DIM A	DIM. B
150 LB SHOWN	43	11
300 LB	43 3/4	12 1/2
400 LB	44 1/4	12 1/2
600 LB	45 1/4	14
900 LB	47 1/2	15
6" PIPE (IPS) LADISH	36 7/8	7 3/16
6" GRAYLOC (6 GR62)	45 1/4	9 1/4
6" NPTM	42	8 5/8

6" ANSI RAISED FACE FLANGE (B 16.5)

D600 WITH FLANGE FITTINGS

Remote Electronics Unit

MICRO MOTION

Features

- UL, CSA, BVS Approved
- Intrinsically Safe Design
- Factory Calibrated to Customer Specifications
- Calibration Traceable to National Bureau of Standards
- Field Adjustable and Replaceable Circuit Boards
- Can be Installed 500 feet from Sensor

Description

Micro Motion mass flow meters feature an Intrinsically Safe electronics compartment which can be located up to 500 feet from the sensor unit.

Factory calibration is directly traceable to the U.S. National Bureau of Standards, and because the meter measures mass flow rate directly, this calibration is unaffected by changing fluid properties.

Electronics are field ready and require only a simple adjustment to set the zero at installation. Should the customer wish to change meter applications, the electronics' printed circuit boards can be easily adjusted or replaced in the field.

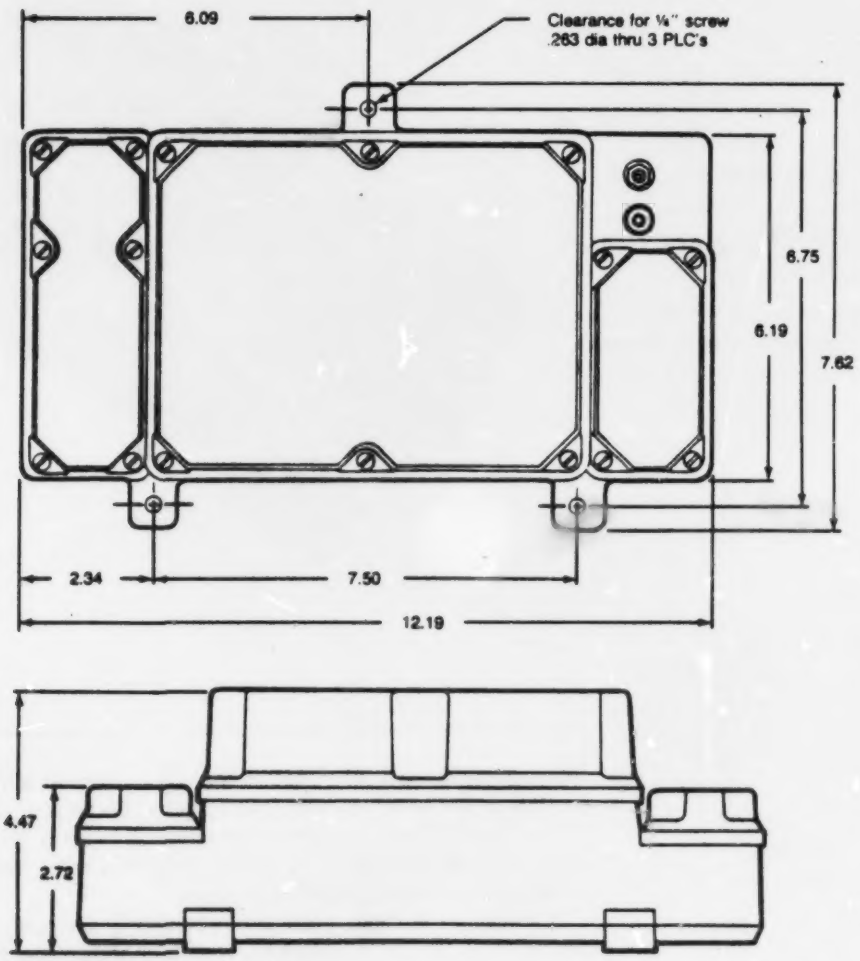
Specifications

Accuracy	±0.4% of rate ± zero stability (in conjunction with flow sensor)
Operating Temperature	−40°F to 150°F (−40°C to 65°C)
Ouput Signals	
Analog:	0-20 or 4-20 mA, 500 ohm max load 0-50 or 10-50 mA, 250 ohm max load 0-5, 1-5, 0-10 or 2-10 VDC, 100k ohm minimum impedance
Frequency:	Max output adjustable from 1.5 to 10,000 Hz Solid state switch, 30 VDC, 1 amp max
Response Time	Adjustable from 0.1 to 1.1 seconds
Power	100, 115, 220 VAC ±10%, 12-30 VDC ±15%, 8 watts
Enclosure	Polyethermide structural foam (Ultem® - product of General Electric Co.)

MILLER ENGINEERING LIMITED,
422 CONSUMERS RD., WILLOWDALE,
M2J 1P8 PHONE (416) 499-4421
1179 DECARIE BLVD., MONTREAL QUE.
H4L 3M8 PHONE (514) 747-5169

Physical Characteristics

Dimensions: inches



TOSHIBA/HOUSTON

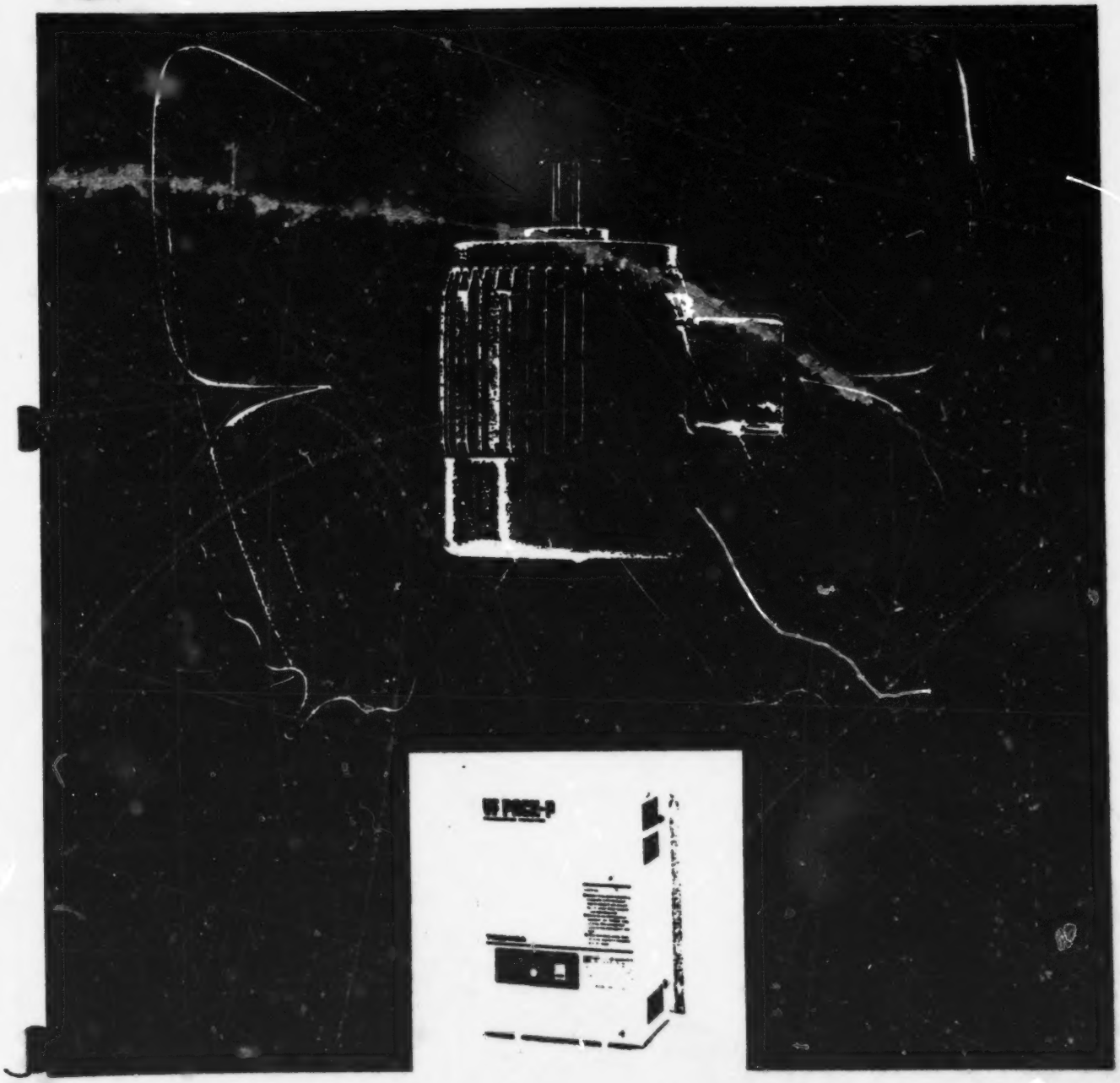
B

SAVE ENERGY

TRANSISTOR INVERTER FOR FAN AND PUMP APPLICATIONS

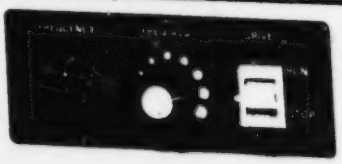
VF PACK-P

1.5 TO 5kVA



VF PACK-P

TRANSISTOR INVERTER



TOSHIBA

TRANSISTOR INVERTER

SOURCE	
CAPACITY	
VOLTS	
FREQUENCY	
CURRENT	
AC MOTOR	MAX
SERIAL NO.	

An Inverter Designed Specifically For Energy Saving

For a proven, dependable means of saving energy, Toshiba introduces a new epoch in transistorized inverters. Toshiba has taken a common sense approach with respect to the various loading which can be imposed upon a motor. Even though this inverter is capable of constant torque operation, its automatic V/Hz circuit provides excellent power saving especially when used in pump and fan applications. It is a compact, sine weighted PWM, microcomputer based inverter incorporating sophisticated protective circuitry and easy to read LED digital displays. It is truely an inverter suited to meeting the energy saving requirements of today's energy conscious environment.

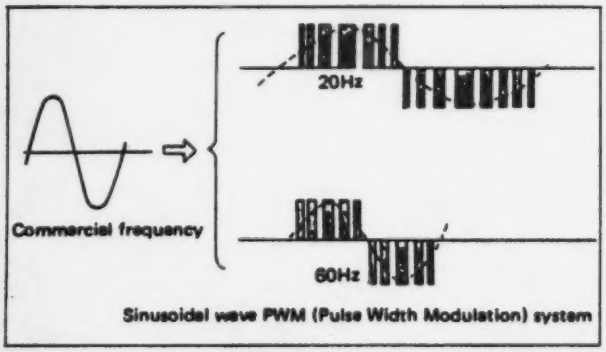
An Economical Inverter For Energy Savings Designed For Pump and Fan Applications

SPECIFICALLY DESIGNED FOR FAN AND PUMP APPLICATIONS

The VF PACK-P has been specifically designed for pump and fan applications to provide the highest system efficiency as compared to other traditional control methods such as dampers or control valves.

SINUSOIDAL WAVE PWM CONTROL

Sine wave PWM control of the VF PACK-P provides for a smooth drive with high efficiency, low harmonic components and less torque ripple. The microcomputer controls the power transistor output.



Sinusoidal wave PWM (Pulse Width Modulation) system

SUBSTANTIAL ENERGY SAVINGS

Since the horsepower varies as the cube of the speed in pump and fan applications even a small reduction in the speed significantly reduces energy consumption. Energy savings combined with economical cost and the ability to use the VF PACK-P with most existing motors add up to quick payback and substantial lower operating costs.

SIMPLE AND COMPACT DESIGN

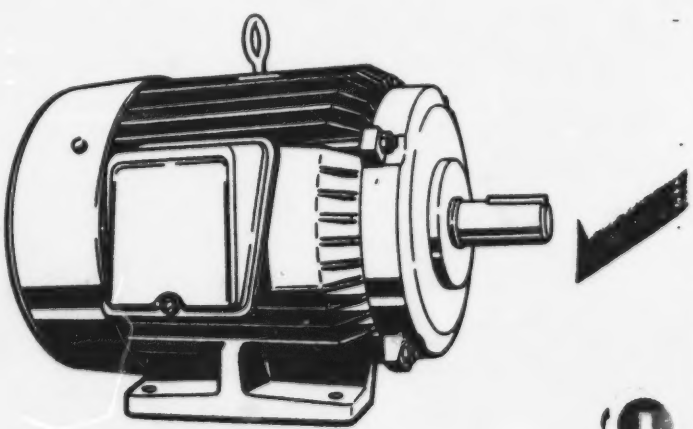
Drawing on Toshiba's industrial experience in other technologies the VF PACK-P has a very compact appearance as compared to other similiar inverters. High reliability is maintained by modularizing the main circuits (giant transistors). Control circuits make wide use of compact integrated circuit components. The compact design contained in a wall mounted box type enclosure makes for a smart appearance.

OPERATIONAL CONTROL PANEL OPTIONS

The VF PACK-P comes with an operational control panel on the front of the enclosure for direct control or can be controlled from a separate operational control unit. Control panel construction and operational method should be selected to match the particular installation's site requirements.

Applicable motor output (HP)	¼	½	1	1½	2	3	5
Inverter capacity (kVA)	1.5			2		3	5
With operation panel (Note 1)	VF10P -2015B0			VF10P -2020B0		VF10P -2030B0	VF10P -2050B0
Without operation panel	VF10P -2015B0			VF10P -2020B		VF10P -2030B	VF10P -2050B

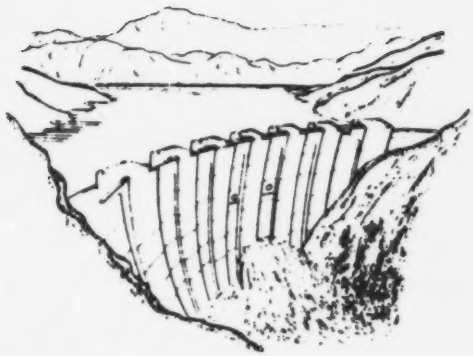
Note 1: Suffix "0" indicated unit has operational panel on the main unit.



PROTECTIVE CIRCUITRY PROVIDED

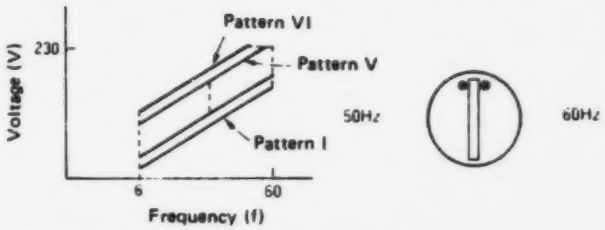
Thorough protective functions provide for a stable and safe operation. Protective circuits include:

- stall prevention
- overcurrent protection
- overvoltage protection
- undervoltage protection
- fuse protection



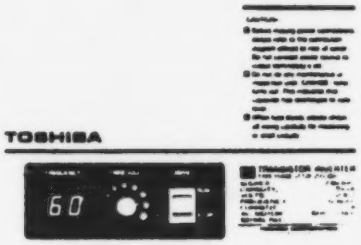
POWER FACTOR IMPROVEMENT

Use of the VF-PACK-P in combination with a motor will in most cases yield an overall power factor improvement over that of the motor alone. This may help in advoiding utility power factor penalties.



VF PACK-P

TRANSISTOR INVERTER



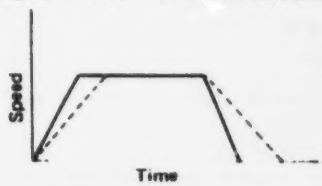
	60 Hz (V/f constant)		50 Hz (V/f constant)
0	Pattern I (low)	8	Pattern I (low)
1	Pattern II (slightly low)	9	Pattern II (slightly low)
2	Pattern III (a little low)	10	Pattern III (a little low)
3	Pattern IV (standard)	11	Pattern IV (standard)
4	Pattern V (slightly high)	12	Pattern V (slightly high)
5	Pattern VI (high)	13	Pattern VI (high)
6	Automatic (I)	14	Automatic (I)
7	Automatic (II)	15	Automatic (II)

MICROCOMPUTER CONTROLLED FOR MINIMUM ENERGY

Besides saving energy through variable speed control the microcomputer controlled VF PACK-P automatically adjusts the V/f ratio. In most general purpose AC motors efficiency is reduced as the load decreases from the rated load. The VF PACK-P by detecting the motor current selects the V/f pattern according to the load amount yielding optimal motor efficiency. The VF PACK-P also has manual selection of constant V/f pattern for highly fluctuating loads as shown in figure.

SELECTABLE ACCELERATION AND DECELERATION TIME

Acceleration and deceleration times can be selected over eight time steps, ranging from 1 to 60 seconds.



Acceleration and deceleration time (sec.)	1, 3, 5, 10, 20, 30, 40, 60

Note: Acceleration time and deceleration time are the same.

Multiple Model Type and Ease of System Interface Provide For a Broad Range of Applications to Various Types of Equipment.

■ Machine and Standard Specifications

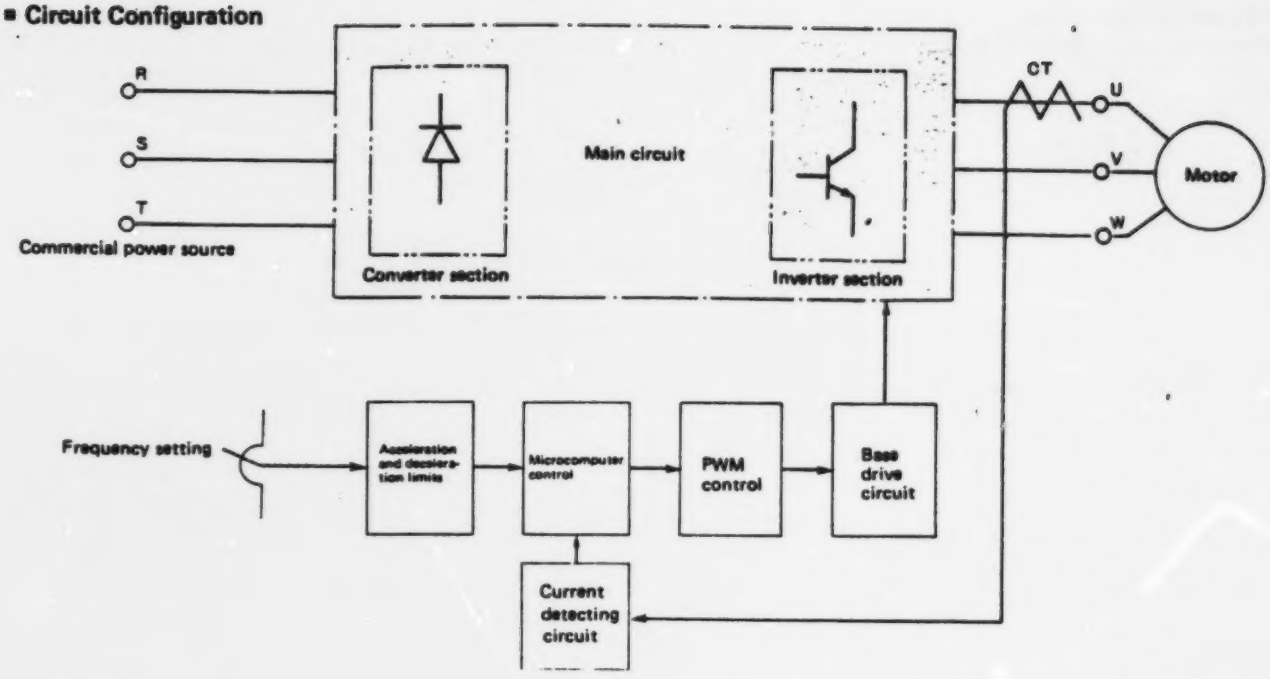
Item		Description						
Applicable motor output (HP)		¼	½	1	1½	2	3	5
Machine rating	Type-form (Note 1)	VF10P-2015BO (with operation panel) VF10P-2015B (without operation panel)			VF10P-2020BO VF10P-2020B		VF10P-2030BO VF10P-2030B	VF10P-2050BO VF10P-2050B
	Capacity (kVA)	1.5			2		3	5
	Rated current (A)	4.5			7		9	15
Power supply	Voltage and frequency	3-phase 230V-60Hz						
	Allowable variation	Voltage max. ±10% frequency max. ±2 Hz						
Control specifications	Control system	Sinusoidal wave PWM control						
	Output voltage	3-phase 230V (max.)						
	Output frequency	6 to 60 Hz (Lowest start frequency 6 Hz)						
	Frequency resolution	0.25 Hz						
	Frequency accuracy	±0.5% of highest frequency (at 25°C ± 10°C)						
	Voltage/frequency ratio	Manual 12-patterns, automatic 4-patterns						
	Overload capacity	150% – 30 sec., 115% – continuous						
	Frequency setting signal	DC 0 to 10V (input resistor 10 kΩ)						
Operating functions	Acceleration and deceleration time	8-step changeover (Approx. 1s, 3s, 5s, 10s, 20s, 30s, 40s, 60s)						
	Braking	Braking through capacitor charging						
	Starting	Run-stop selector switch						
	Forward and reverse operation	Reversing is possible by A maintained contact.						
Protecting functions	Protecting function	Stall prevention, overcurrent protection, overvoltage protection, under voltage protection, burning protection (protection by fuse)						
	Fault detecting signal	Relay by B maintained contact. Outputs at overcurrent, overvoltage and undervoltage protection						
	Display	Lamp (LED) on printed circuit board (in inverter) lights when charging capacitor.						
Ambient conditions	Location	Indoor						
	Ambient temperature	0 to 40°C (around the box)						
	Ambient humidity	Less than 90% (relative) (no dew condensation)						
	Vibration	Less than 0.5G						
Construction		Box type (non-dustproof type)						
Panel mounting instrument (with operation panel)		Frequency meter (digital display) Frequency setting rheostat (3 kΩ-1W), Run-stop switch						
Coating color		Munsell 5Y 7/1						

Note 1: In the last symbol of type-form, "BO" indicates "with operation panel", and "B" indicates "without operation panel".

■ Optional Specifications

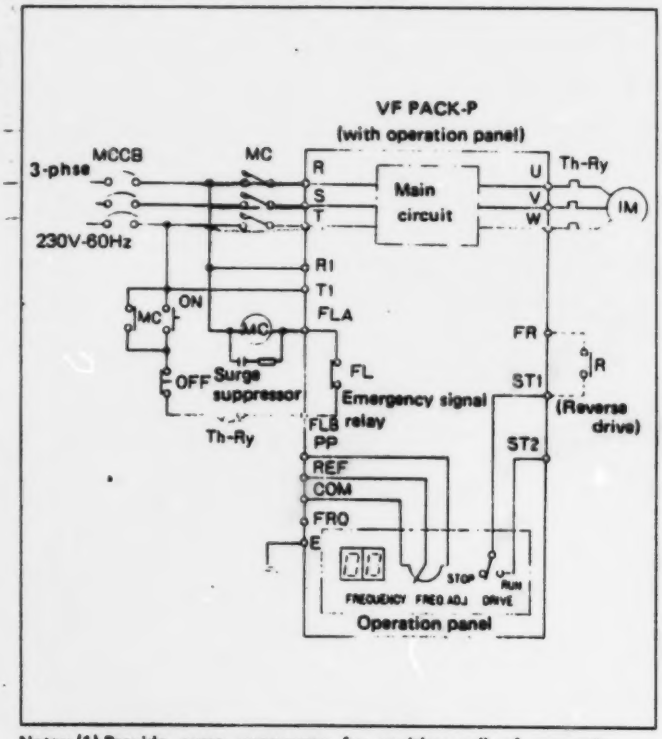
Specifications	Description
Operation panel	Remote operation panel for VF PACK-P without operation panel. Builts-in frequency meter, speed setting rheostat and ON-OFF pushbutton switch.
Regenerative power discharging unit	In large inertia loads such as fan and brower, this is used when large braking torque is required at deceleration.
Various application control	In combination with application control device, energy-saving control such as pump discharge pressure control, or flow-control or airflow-control for fan and blower can be performed

■ Circuit Configuration



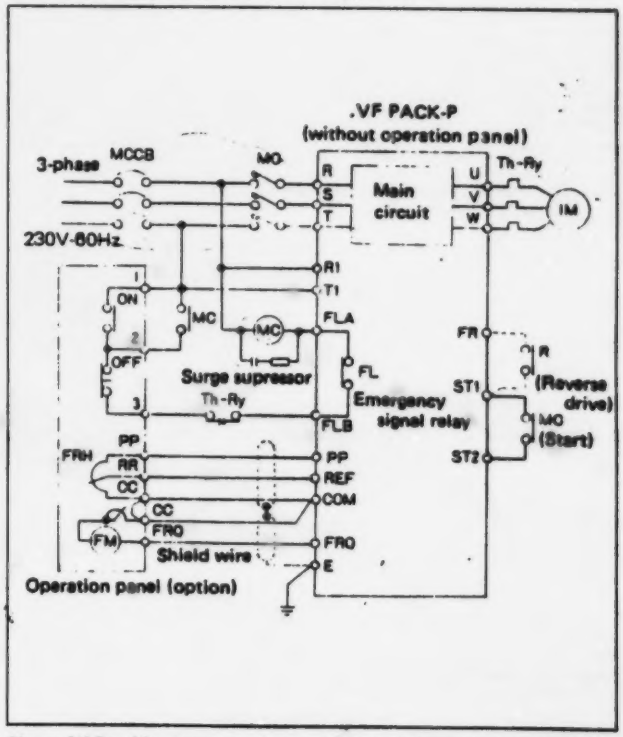
■ Standard Connection Diagram

• With Operation Panel (Type BO)



Notes: (1) Provide surge suppressor for exciting coil of magnetic contactor MC.
(2) For operation, energize MC contactor and then START and STOP with "RUN" selector switch.
(3) When reversing is required, short between terminals FR and ST1.

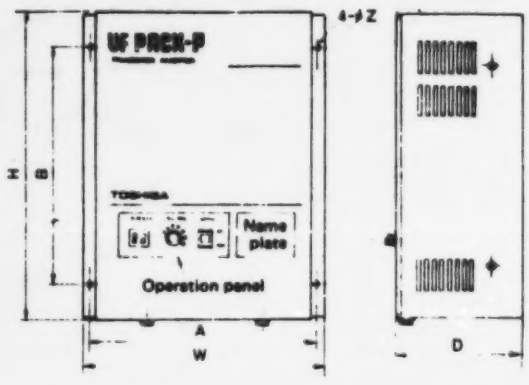
• Without Operation Panel (Type B)



Notes: (1) Provide surge suppressor for exciting coil of magnetic contactor MC.
(2) When starting with A switch other than the MC auxiliary contact, interlock with MC.
(3) When reversing is required, short between terminals FR and ST1.

■ External Dimensions

• Inverter Unit (VF PACK-P)

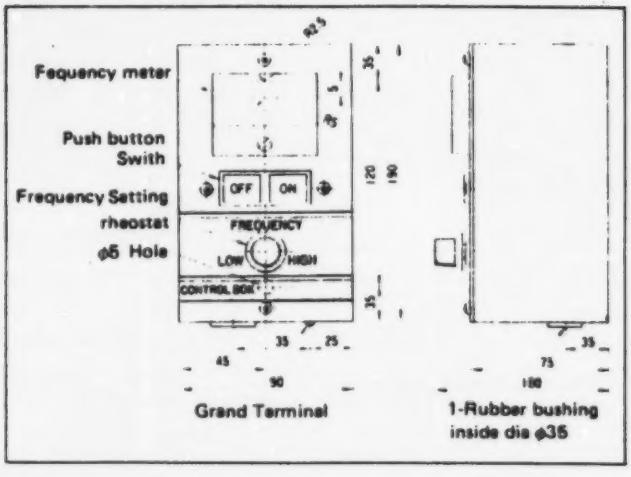


(mm)

Capacity (kVA)	Type-form	W	H	D	A	B	Z	Weight (kg)
1.5	VF10P-20158, SO	230	260	130	215	220	6	5
2	VF10P-20208, SO							
3	VF10P-20308, SO	284	367	166	268	280	7	9.2
5	VF10P-20508, SO							

Note: When the end of type-form is "S", operation panel is not provided.

• Operation Panel (Type-form CBV–SE)



• Provision Devices on Operation Panel

Name	Type-form	Rating	Outline drawing No.
Frequency meter	SA-65	7.5V-1mA 60 Hz	1
Calibration rheostat for the above	RV24YL-15S-B30K	30 kΩ-0.25 W	2
Frequency setting rheostat (with scale plate and knob)	RV30YN-20S-B3K (knob K-2198)	3 kΩ-1.0 W	3
Pushbutton switch	PB203-281	250V-5A	–

Fig.1 Frequency Meter (SCF–6)

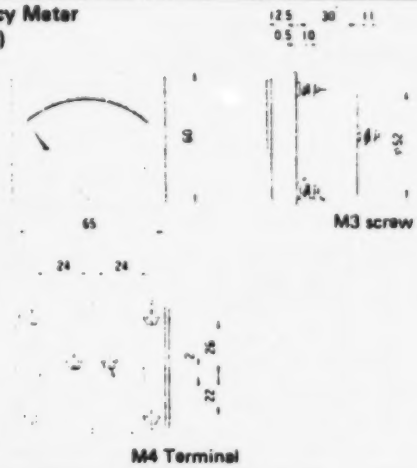


Fig. 2. Frequency Meter Calibration Rheostat (RV24YL-15S-B30K)

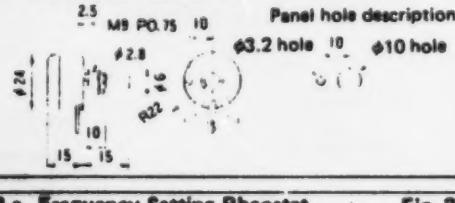


Fig. 3-a. Frequency Setting Rheostat (RV30YN-20S-B3K)

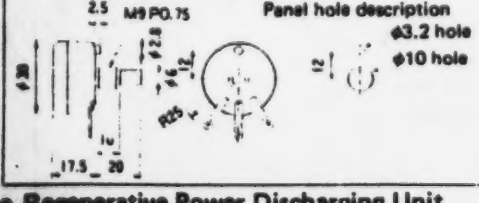


Fig. 3-b. Scale Plate for Frequency Setting Rheostat

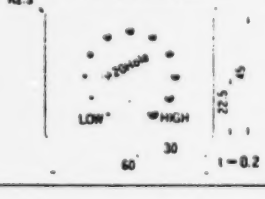
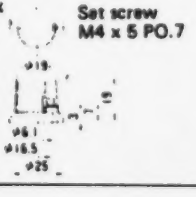
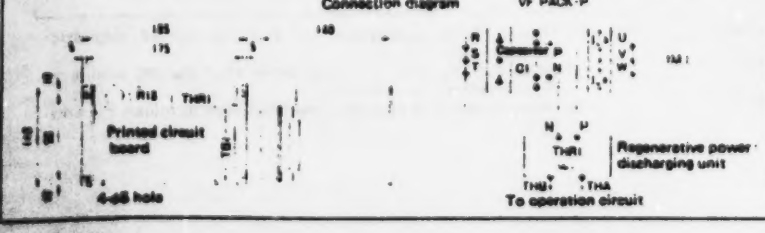


Fig. 3-C Frequency Setting Rheostat Knob (K–3)



• Regenerative Power Discharging Unit



Type-form and Rating

Inverter type-form	Discharging unit type-form	Capacity and resistance
VF10P-20158, SO	VF-PB15	40W-100Ω
VF10P-20208, SO	VF-PB30	80W- 50Ω
VF10P-20308, SO		
VF10P-20508, SO	VF-PB50	80W- 50Ω

The VF PACK-P Can Achieve Significant Energy Saving

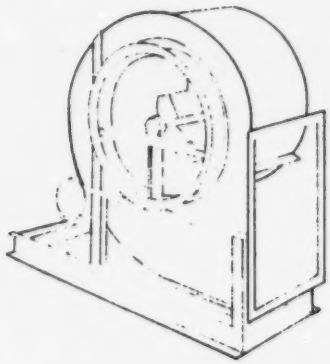
- **Application, Power-Saving Effect**
- VF PACK-P was specifically designed for fan, blower, and pump applications.

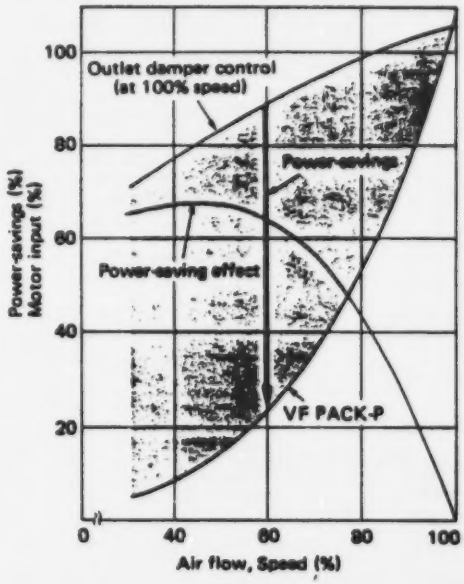
Losses can be minimized and large energy savings can be realized with inverter speed control in comparison to dampers or control valves. With an inverter the following relations exist:

Flow $\propto$ Speed

Required Power $\propto$ Flow^3

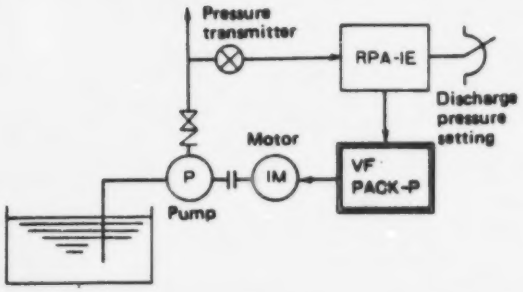
for example, at 80% flow (speed), power required = $(0.8)^3$ = 50%. A small flow or speed change, therefore, can result in a significant energy savings.





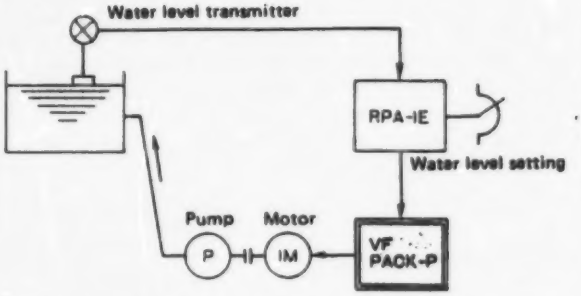
APPLICATION OF VF PACK-P

■ For Constant Discharge Pressure Control



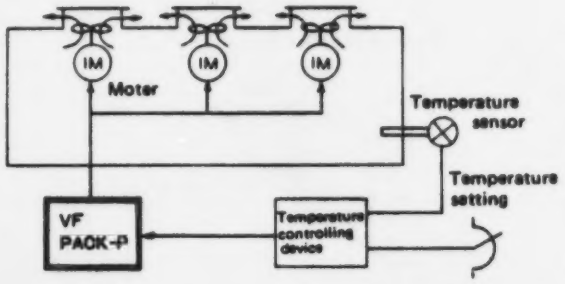
Constant discharge pressure control of the pump is performed by combining VF PACK-P and the process control panel RPA-IE having a built-in PI controller. The control can be applied to the pump control in the process line and in the tankless water supply system.

■ For Constant Water Level Control, etc.



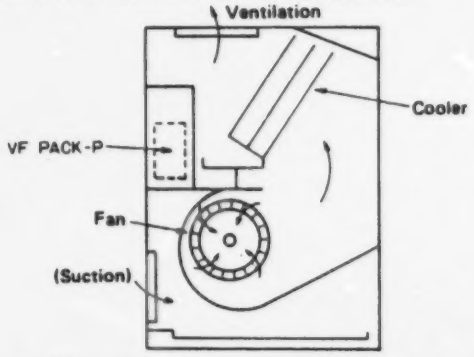
By changing the detector to water level transmitter, flow transmitter etc., constant water level control and constant flow control can be performed.

■ For Airflow Control of Ventilating Fan



Temperature is controlled by controlling the speed of the ventilating fan of an exhausting dryer. One VF PACK-P can drive multiple of ventilating fans.

■ For Airflow Control of Air Conditioner



Fan speed is controlled by VF PACK-P for continuous temperature and humidity control of a room. Large energy-saving drive can be performed compared with conventional damper control.

■ In Ordering VF PACK-P

In ordering, inform the following:

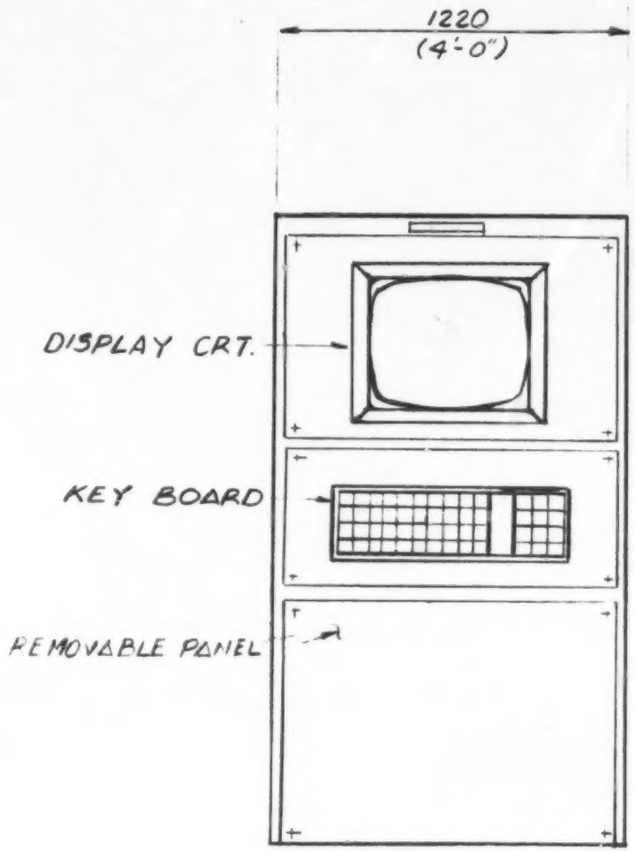
Machine application	Type Manufacturer Application	Fan, blower, pump, others ( )		
Motor specifications	Rated output	HP	No. of poles	
	Rated voltage	V	Rated frequency	Hz
	Rated current	A	Time rating	
	Type-form		Maker	
Inverter specifications	Rated capacity	kVA	Power supply	V Hz
	Output voltage	V	Output frequency	Hz
	Control range	Hz to Hz rpm to rpm		
	Construction	With operation panel · Without operation panel		
	Option			
Driving condition	Start frequency			
	Acceleration, deceleration time	Specification None · Yes (s.)		
	Load WK^2			
	Regenerative brake	Required (regenerative power discharging unit used) · not required		
	No. of drive motors	1-set · several sets (sets)		
Other specified items				

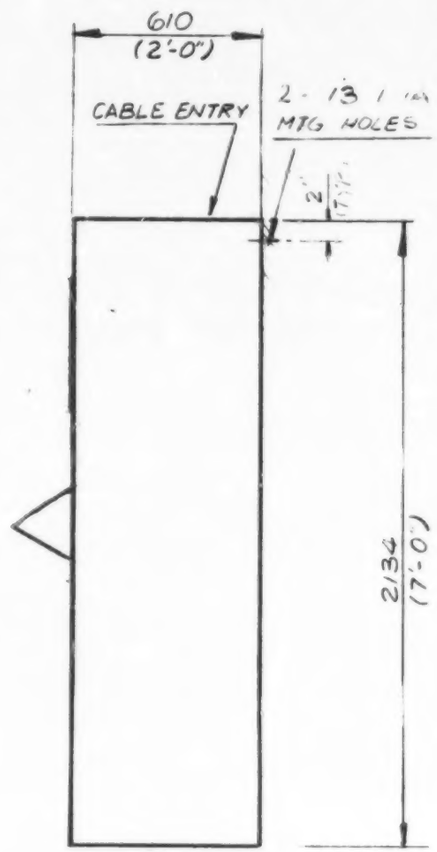
OR FURTHER INFORMATION CONTACT

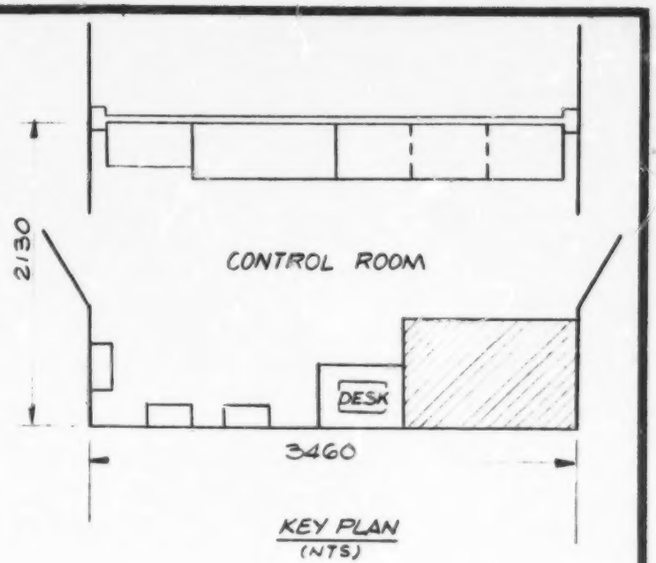
TOSHIBA/HOUSTON
INTERNATIONAL CORPORATION

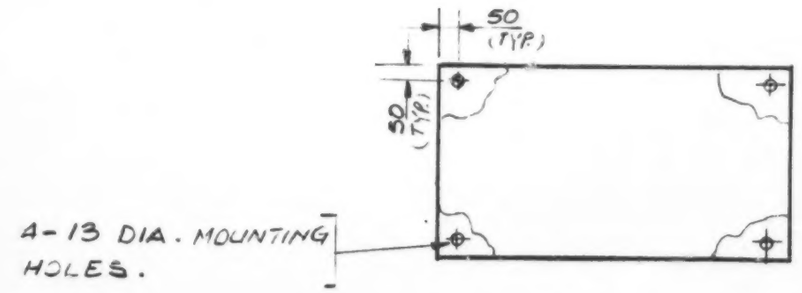
13131 WEST LITTLE YORK ROAD
P.O. BOX 40906, HOUSTON, TEXAS 77040, U.S.A.
TEL.: (713) 466-0277 TELEX: 762078

Printed in Japan









PLAN

SUBJECT TO APPROVAL
BEFORE CONSTRUCTION

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE
0			

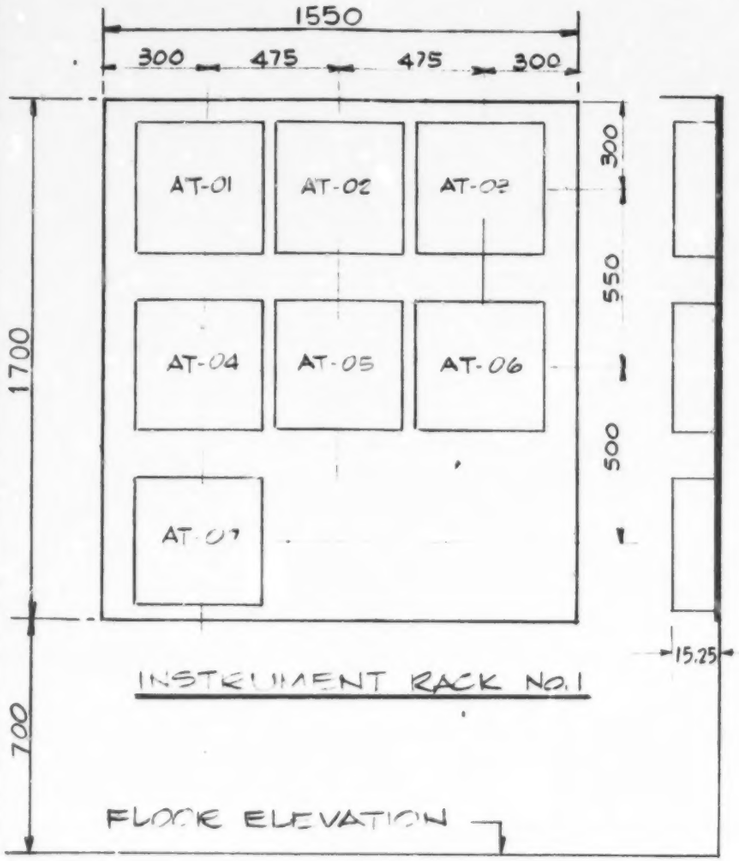
Fenco
Fenco Engineers Inc.

CANMET:
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

TITLE:
CENTRAL CONTROL SYSTEM
PANEL LAYOUT

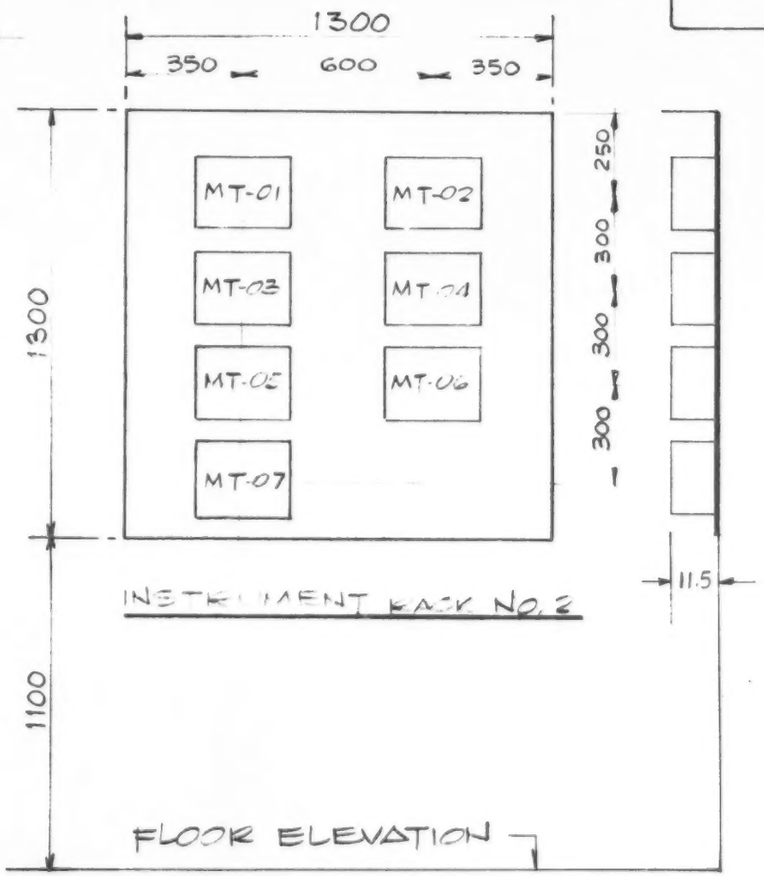
DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MISC.	PROJET	APPROUVÉ
J.J.	RVO				DSW	
DATE 84.12.7	DATE 85.1.15	DATE	DATE 24 Jan 85	DATE	DATE 24/01/25	DATE

ÉCHELLE	No. DESSIN	REV.
1:20	42022-I-01	0



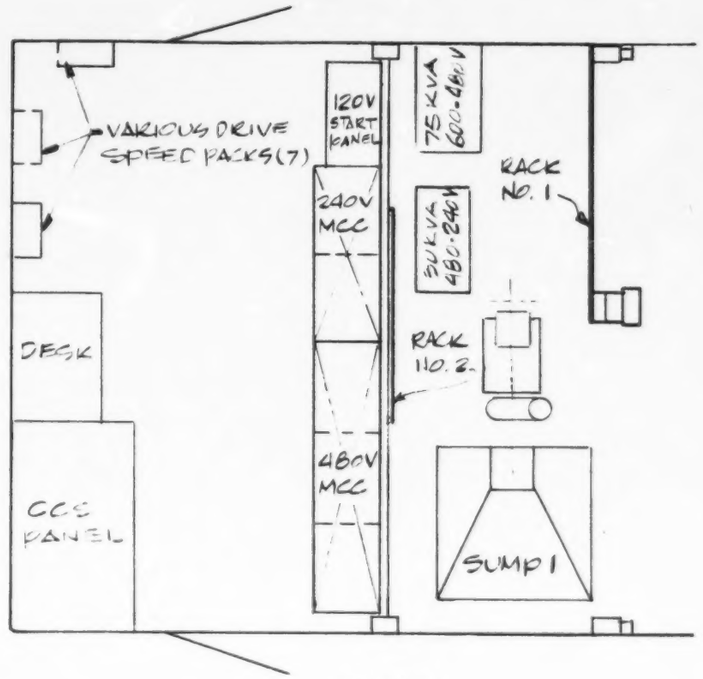
INSTRUMENT RACK NO.1

FLOOR ELEVATION



INSTRUMENT RACK NO.2

FLOOR ELEVATION



PLAN

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE
0			

Fenco
Fenco Engineers Inc.

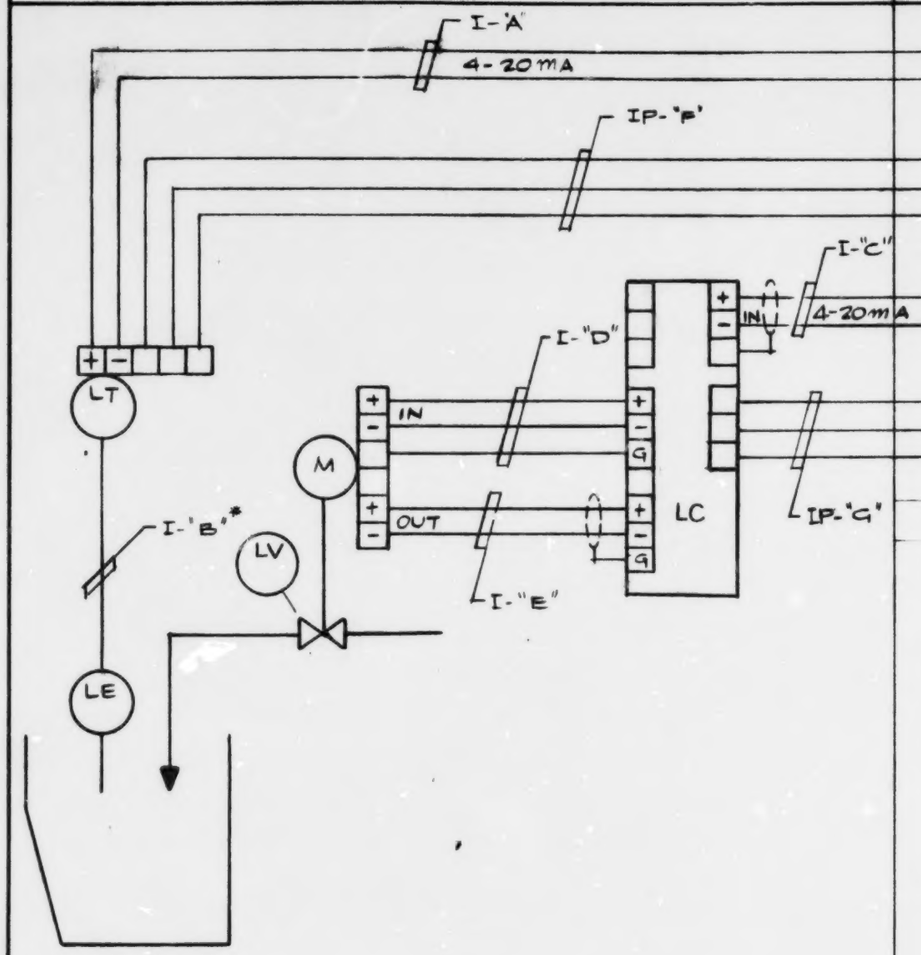
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING PILOT PLANT

INSTRUMENT RACKS LAYOUT

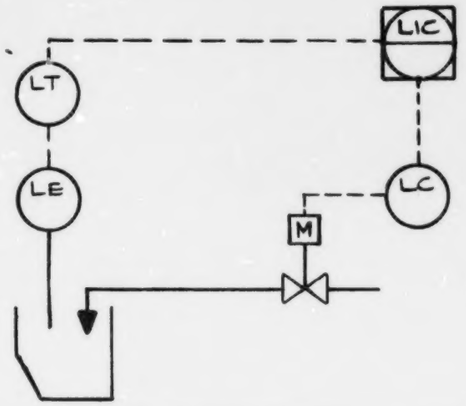
DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MÉC.	PROJET	APPROUVÉ
B.B.T.					DSW	
DATE 84.12.7	DATE 85 01 24	DATE	DATE 24 Jan 85	DATE	DATE 29/01/85	DATE

ÉCHELLE NTS | No. DESSIN 42022-I-02 | REV. 0

Field	Instrument Rack	CCS Term	Schematic Loop Diagram



*SUPPLIED WITH INSTRUMENTS



Control Room

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

Loop No.	Cable/Wire No. A	B	C	D	E	F	G
LIC-01							
LIC-02							
LIC-03							
LIC-04							
LIC-06							
LIC-07							
LIC-08							

Tag. No.	Calib.	Input	Output	Spec.
LE/LT-08	0-630	N/A	4-20	
LE/LT-07	0-830	N/A	4-20	
LE/LT-06	0-830	N/A	4-20	
LE/LT-04	0-680	N/A	4-20	
LE/LT-03	0-680	N/A	4-20	
LE/LT-02	0-900	N/A	4-20	
LE/LT-01	0-900	N/A	4-20	

Instrument Calibration

No.	Revision	Date

Notes:

1. CALIBRATION IS GIVEN IN mm

Ref. Dwg. No.	Reference Dwg. Title

Fenco

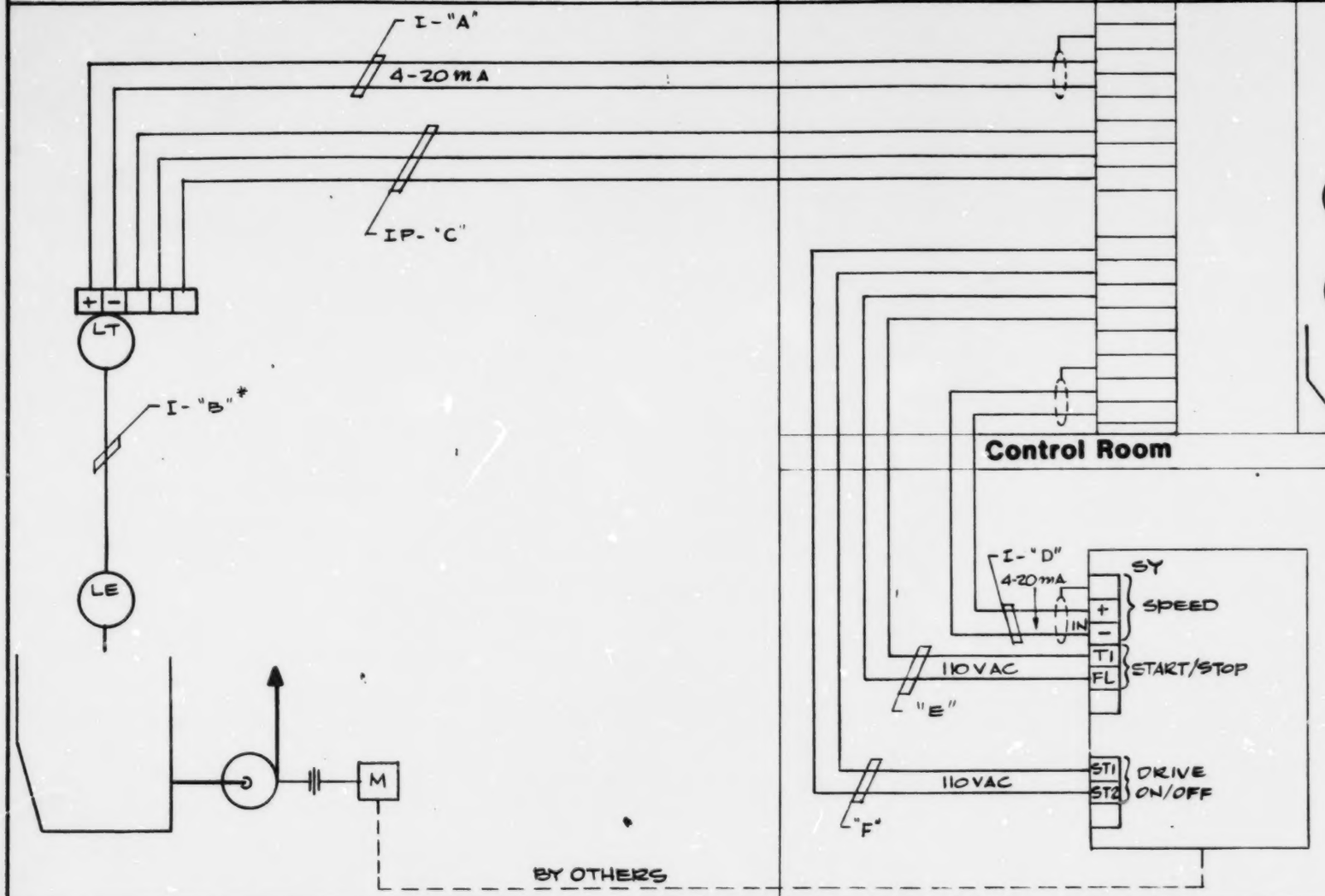
CANMET:
COAL RESEARCH LABORATORIES
FINE COAL CLEANING,
MOBILE PLANT

FLOW LOOP DIAGRAM
(TYP. #1)

	Dessiné	Verifié	Instr	Project	Approuvé
Par	B.B.T.	R.V.O		D.J.W	
Date	07.01.85	85-01-10	24 Jan 85	24/01/85	

Echelle | No. Dessin 42022-3-08 Sheet 1 | Rev. 0

Field	Instrument Rack	CCS Term	Schematic Loop Diagram



Loop No.	Cable/Wire No.						
	"A"	"B"	"C"	"D"	"E"	"F"	
LIC-05							

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

LE/LT-05	0-900	N/A	4-20	
Tag. No.	Calib.	Input	Output	Spec.

Instrument Calibration

No	Revision	Date

Notes:

1. CALIBRATION IS GIVEN IN mm

Ref. Dwg. No.	Reference Dwg. Title

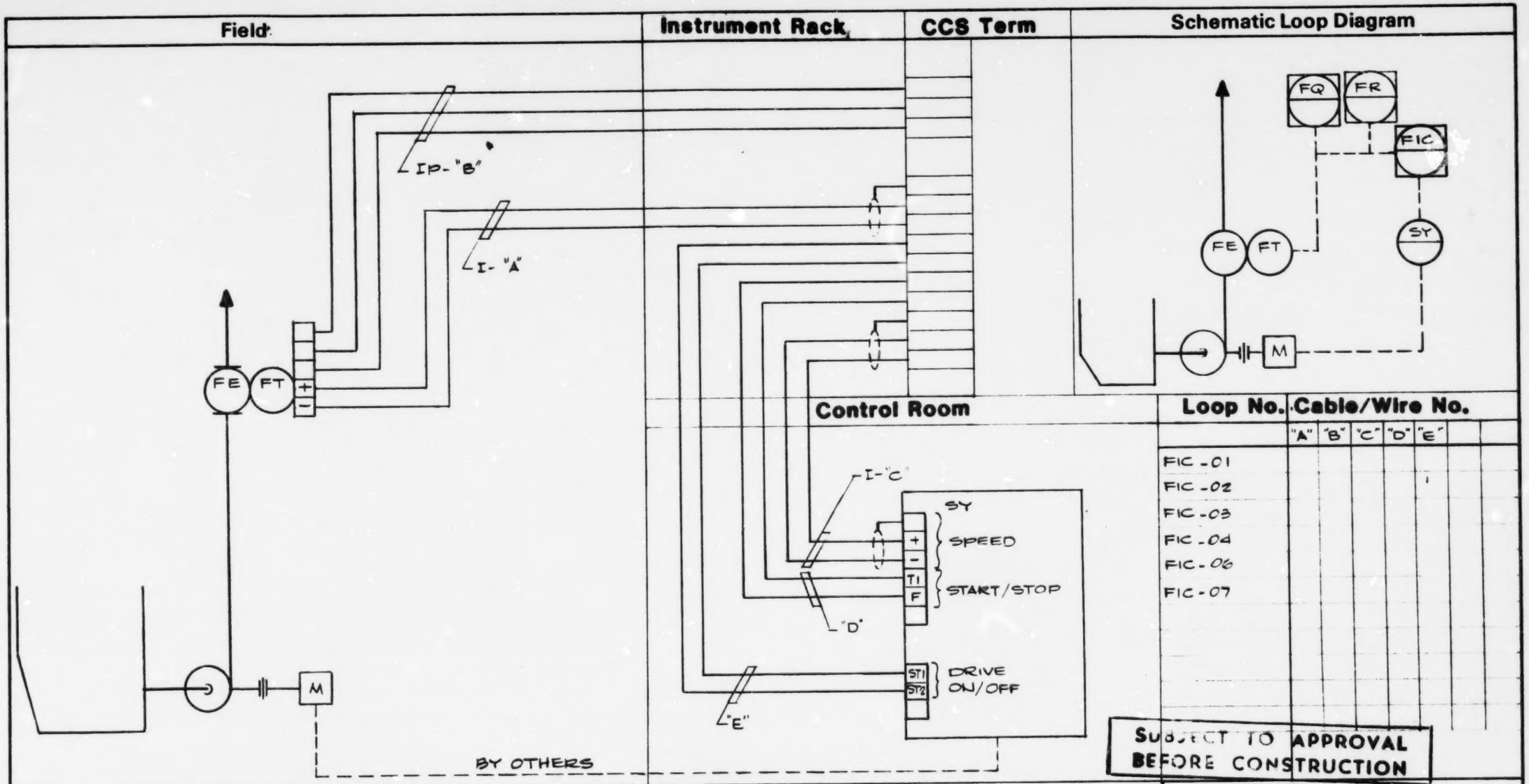
Fenco

CANMET;
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

LEVEL LOOP DIAGRAM
(TYP. # 2)

	Dessiné	Verifié	Instr	Project	Approuvé
Par	B.B.T.	RVO			
Date	09.01.85	85-01-10	24 Jan '85		

Echelle | No Dessin 42022-I-08 Sheet 2 | Rev 0



Loop No.	Cable/Wire No. "A"	"B"	"C"	"D"	"E"
FIC-01					
FIC-02					1
FIC-03					
FIC-04					
FIC-06					
FIC-07					

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

Tag. No.	Calib.	Input	Output	Spec.
FT-07	0-9	N/A		
FT-06	0-18	N/A		
FT-04	0-3,5	N/A		
FT-03	0-17	N/A		
FT-02	0-17	N/A		
FT-01	0-17	N/A		

Instrument Calibration

No	Revision	Date

Notes:
1. CALIBRATION IS GIVEN IN m^3/h

Ref. Dwg. No.	Reference Dwg. Title

Fenco

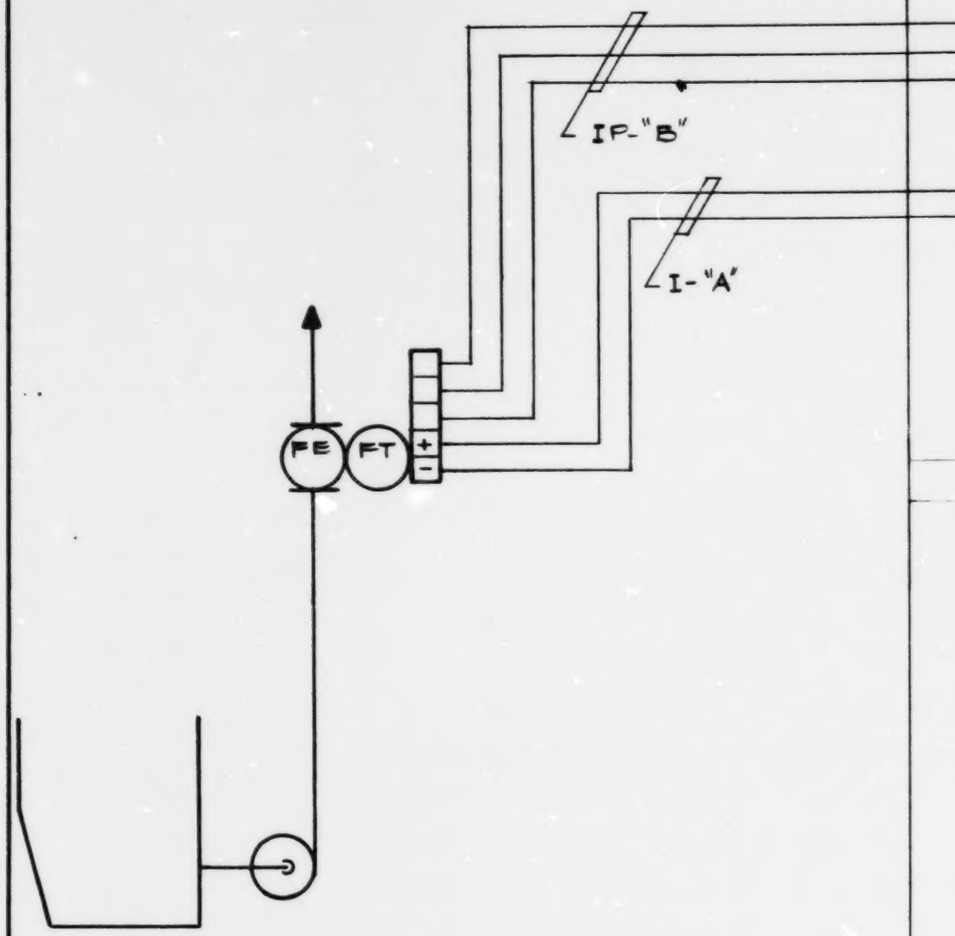
CANMET:
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

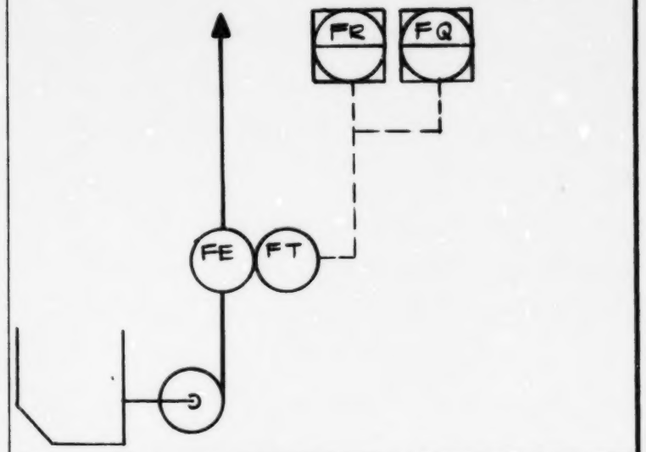
FLOW LOOP DIAGRAM
(TYPICAL # 1)

	Dessiné	Vérifié	Instr	Project	Approuvé
Par	D.B.T.	RVO	[illegible]	DSW	
Date	09.01.85	85-1-10	24 [illegible] 15	24/01/85	

Échelle | No. Dessin 42022-3-03 Sheet 3 | Rev. 0

Field	Instrument Rack	CCS Term	Schematic Loop Diagram





Control Room

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

Loop No.	Cable/Wire No.	
	"A"	"B"
FR-05		

Tag. No.	Calib.	Input	Output	Spec.
FT-05	0-30	N/A	4-20	

Instrument Calibration

No.	Revision	Date

Notes:

1. CALIBRATION IS GIVEN IN m^3/h

Ref. Dwg. No.	Reference Dwg. Title

Fenco

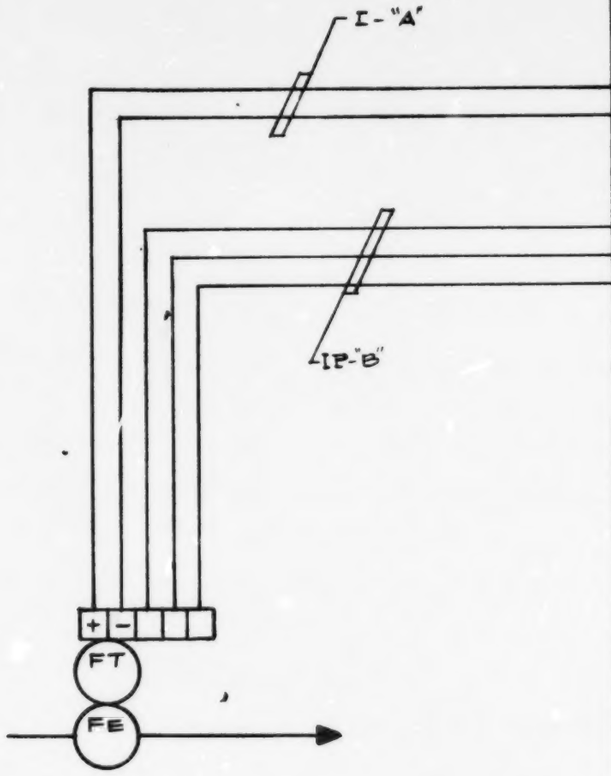
CANMET:
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

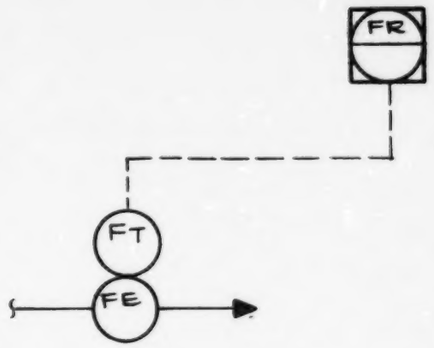
FLOW LOOP DIAGRAM
(TYP. # 2)

	Dessiné	Verifié	Instr	Project	Approuvé
Par	B. B. T.	RVO	[illegible]	D & W	
Date	09.01.85	85-1-10	20 Jan 85	29/01/85	

Échelle | No. Dessin 42022-[illegible] 4 | Rev 0

Field	Instrument Rack	CCS Term	Schematic Loop Diagram





Control Room

Loop No.	Cable/Wire No. "A"	Cable/Wire No. "B"
FR-09		
FR-10		

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

Tag. No.	Calib.	Input	Output	Spec.
FT-10	0-5	N/A	4-20	
FT-09	0-15	N/A	4-20	

Instrument Calibration

No	Revision	Date

Ref. Dwg. No.	Reference Dwg. Title

Notes:

1. CALIBRATION IS GIVEN IN m^3/h

Fenco

CANMET:
COAL RESEARCH LABORATORIES

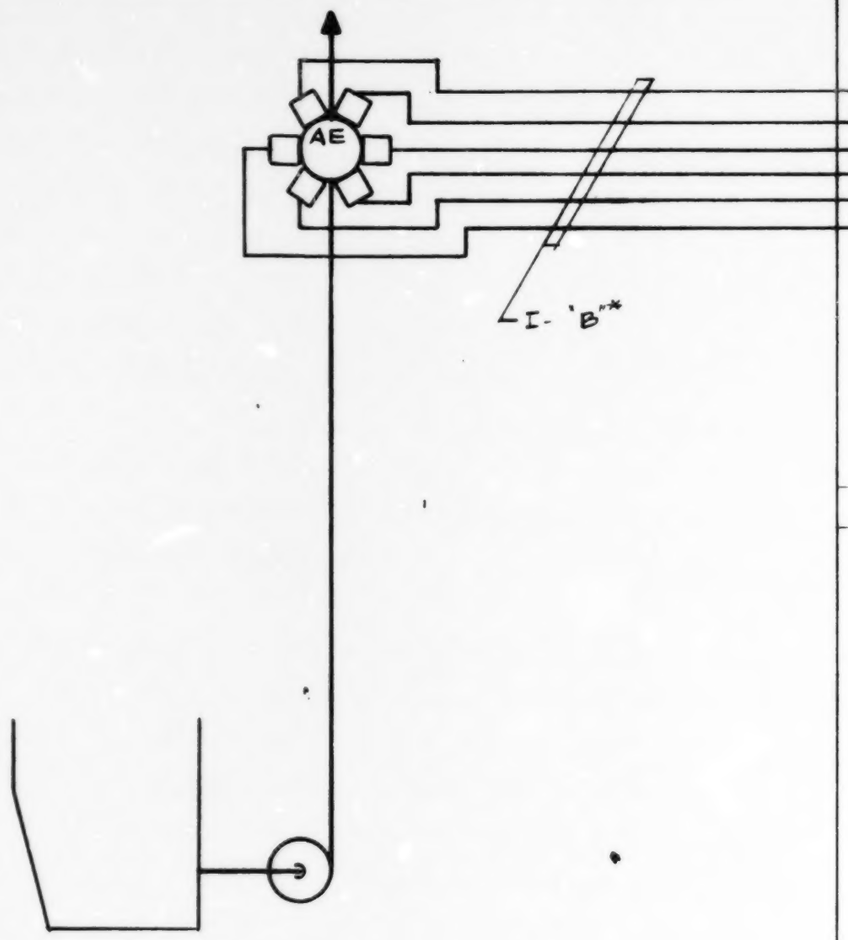
FINE COAL CLEANING
MOBILE PLANT

FLOW LOOP DIAGRAM
(TYP. # 3)

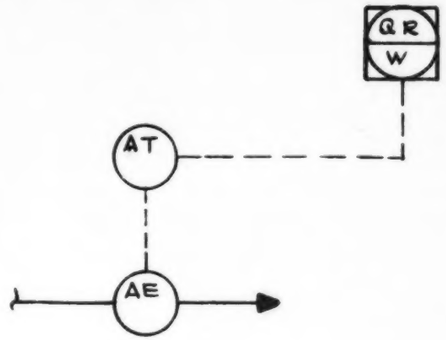
	Dessiné	Vérifié	Instr	Project	Approuvé
Par	B.T.	RVO	Glenn	D.S.W.	
Date	09.01.85	85-01-10	24 Jan 85	24/01/85	

Échelle | No. Dessin 42022-5-03 | Sheet 5 | Rev 0

Field	Instrument Rack	CCS Term	Schematic Loop Diagram



* SUPPLIED WITH INSTRUMENTS



Control Room

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

Loop No.	Cable/Wire No. "A"	"B"	"C"				
QR-01W							
QR-02W							
QR-03W							
QR-04W							
QR-05W							
QR-06W							
QR-07W							

Tag. No.	Calib.	Input	Output	Spec.
AE/AT-07W		N/A	4-20	
AE/AT-06W		N/A	4-20	
AE/AT-06W		N/A	4-20	
AE/AT-04W		N/A	4-20	
AE/AT-03W		N/A	4-20	
AE/AT-02W		N/A	4-20	
AE/AT-01W		N/A	4-20	

Instrument Calibration

No	Revision	Date

Notes:

1. CALIBRATION WILL BE DEFINED BY SUPPLIER.

Ref. Dwg. No.	Reference Dwg. Title

Fenco

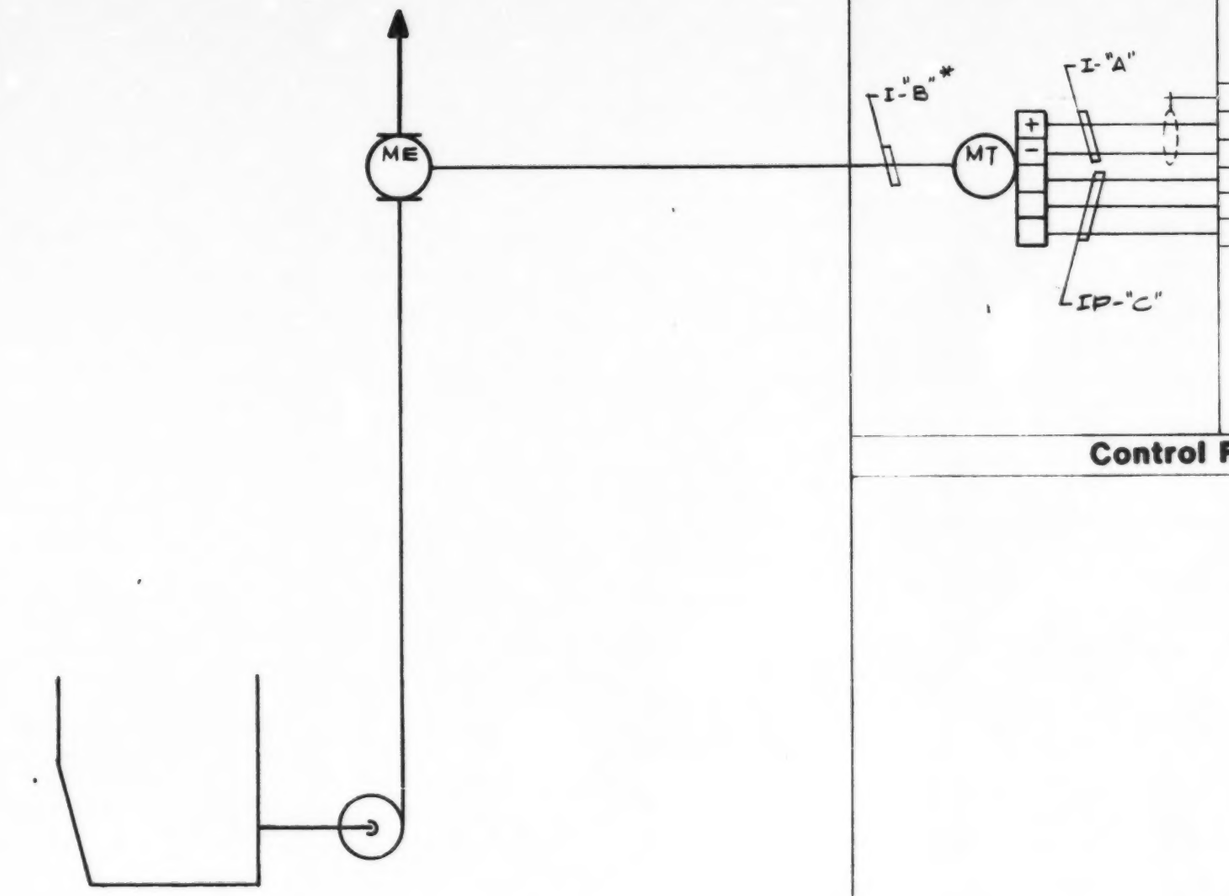
CANMET:
COAL RESEARCH LABORATORIES
FINE COAL CLEANING,
MOBILE PLANT

CONDUCTIVITY LOOP DIAGRAM
(TYP. #1)

	Dessiné	Verifié	Instr	Project	Approuvé
Par	B.B.T.	RVO	Hum	D.S.W.	
Date	09.01.86	85-10	29 Jan '85	29/01/85	

Échelle — No Dessin 42022-5-08 Sheet 6 — Rev D

Field	Instrument Rack	CCS Term	Schematic Loop Diagram



*SUPPLIED WITH INSTRUMENTS

Control Room

Loop No.	Cable/Wire No. "A"	"B"	"C"
MR-01P			
MR-02P			
MR-03P			
MR-04P			
MR-05P			
MR-06P			
MR-07P			

Tag. No.	Calib.	Input	Output	Spec.
ME/MT-07P		N/A	4-20	
ME/MT-06P		N/A	4-20	
ME/MT-05P		N/A	4-20	
ME/MT-04P		N/A	4-20	
ME/MT-03P		N/A	4-20	
ME/MT-02P		N/A	4-20	
ME/MT-01P		N/A	4-20	

Instrument Calibration

No	Revision	Date

Notes:

1. CALIBRATION WILL BE DEFINED BY SUPPLIER.

Ref. Dwg. No.	Reference Dwg. Title

Fenco

CANMET:

COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

MASS FLOW LOOP DIAGRAM
(TYP. #1)

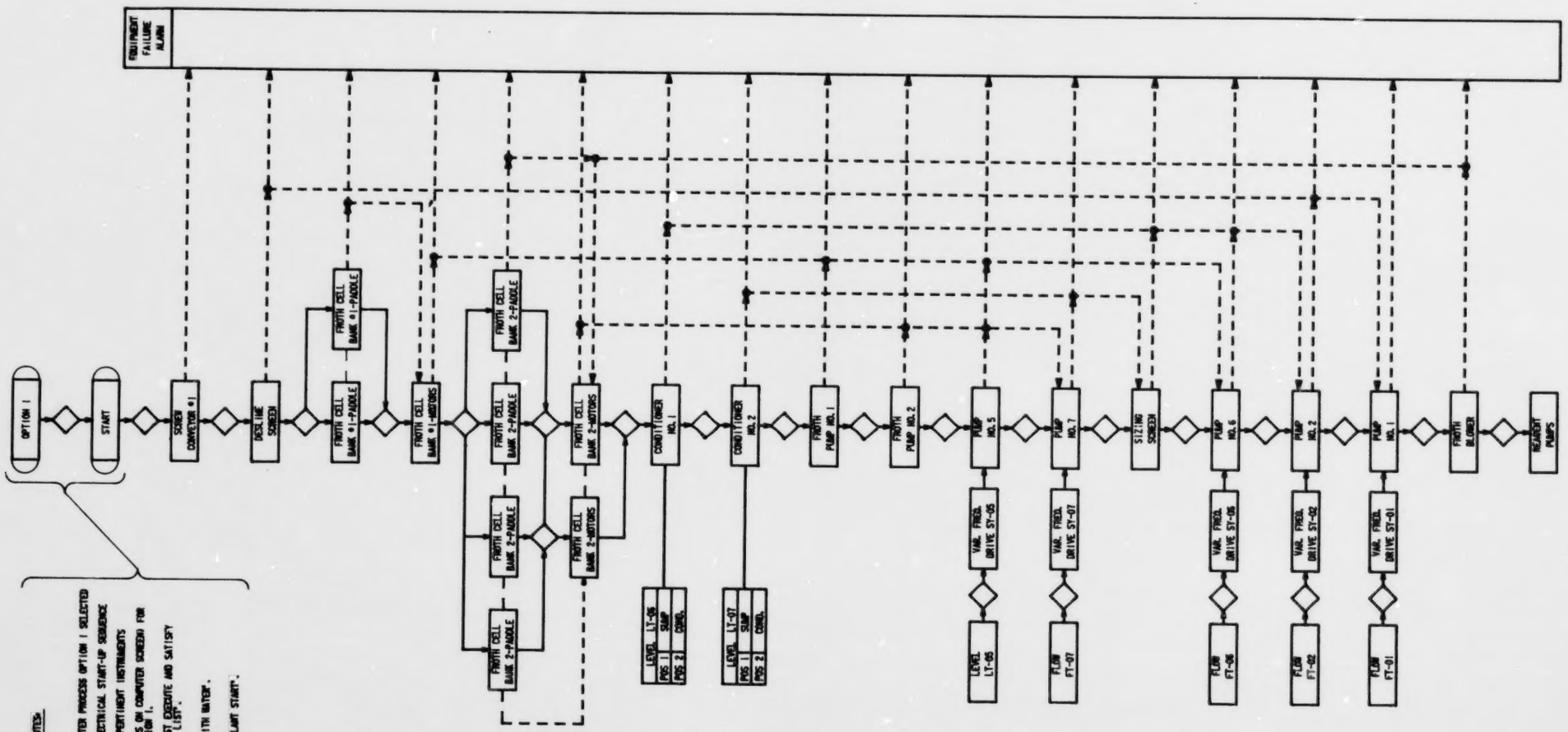
	Dessiné	Verifié	Instr	Project	Approuvé
Par	B.B.T.	RVO		D S W	
Date	09.01.85	85-01-10	29/01/85	29/01/85	

Échelle | No. Dessin 42022-1-00 | Sheet 7 | Rev 0

LEGEND

- START AND PERMISSIVE
- SHUT DOWN AND ALARM
- CONTROL CONTROL SYSTEM
- ELECTRICAL CONTROL EQUIPMENT
- MANUAL INPUT

SUBJECT TO APPROVAL BEFORE CONSTRUCTION



SYSTEM PRE-STARTUP NOTES:

1. LOAD COMPUTER
   - -TELL COMPUTER PROCESS OPTION 1 SELECTED
   - -SETS UP ELECTRICAL START-UP SEQUENCE
   - -POWERS UP PERTINENT INSTRUMENTS
2. CHECK LIST APPEARS ON COMPUTER SCREEN FOR PROCESS OPTION 1.
   OPERATOR MUST EXECUTE AND SATISFY THIS "CHECK LIST".
3. COMMAND TO "FILL WITH WATER".
4. COMMAND COMPUTER "PLANT START".

REFER AND REFERENCES

NO.	REVISION	DATE	BY

ORIG. DATE	09 JAN 1985
DRAWN BY	E. D. A.
CHECKED BY	J. GRANT
APPD. BY	
ISSUE DATE	
ISSUED FOR	

PROJECT TITLE:
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

DRAWING TITLE:
LOGIC SEQUENCE DIAGRAM
PROCESS OPTION 1

Fenco
FENCO ENGINEERS INC

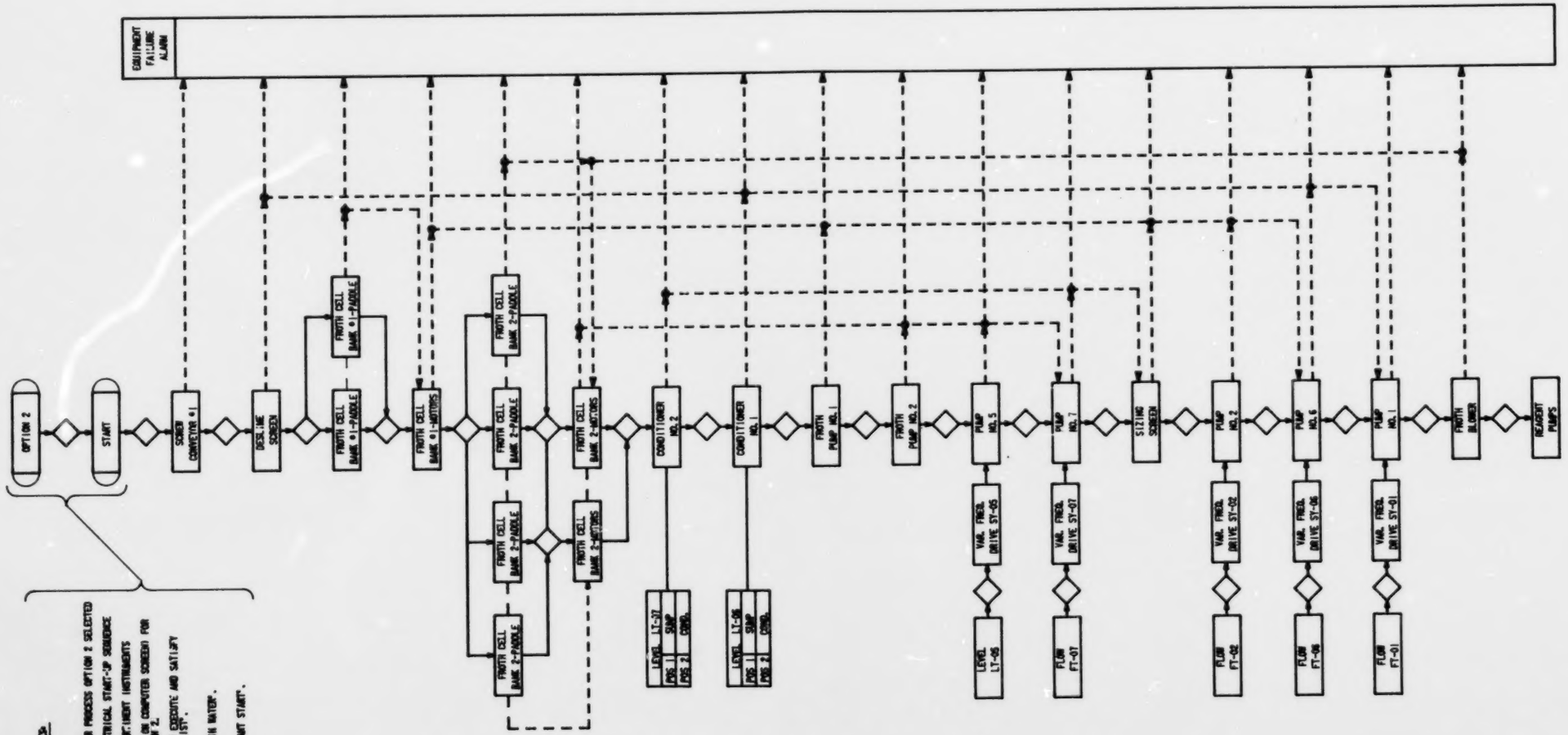
SCALE: NONE

DRAWING NUMBER: 42022-I-11

REV. 0

SUBJECT TO APPROVAL
BEFORE CONSTRUCTION

LEGEND
- START AND PERMISSIVE
- SHUT DOWN AND ALARM
- CENTRAL CONTROL SYSTEM
- ELECTRICAL CONTROL EQUIPMENT
- MANUAL INPUT



SYSTEM PRE-STARTUP NOTES:

1. LOAD COMPUTER
   - -TELL COMPUTER PROCESS OPTION 2 SELECTED
   - -SETS UP ELECTRICAL START-UP SEQUENCE
   - -POWERS UP PERTINENT INSTRUMENTS
2. CHECK LIST APPEARS ON COMPUTER SCREEN FOR PROCESS OPTION 2.
   OPERATOR MUST EXECUTE AND SATISFY THIS CHECK LIST.
3. COMMAND TO 'FILL WITH WATER'.
4. COMMAND COMPUTER 'PLANT START'.

NOTES AND REFERENCES

NO.	REVISION	DATE	BY

DRN. DATE	10 JAN 1985
DESIGN BY	MARC ROSS
CHECKED BY	J. GRANT
DEPT. HEAD	D.S. Webster
ISSUE DATE	
ISSUED FOR	

PROJECT TITLE
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

DRAWING TITLE
LOGIC SEQUENCE DIAGRAM
PROCESS OPTION 2

Fenco
FENCO ENGINEERS INC

SCALE: NONE

DRAWING NUMBER: 42022-I-12
REV. NO. 0

LEGEND:
- START AND PERMISSIVE
- SHUT DOWN AND ALARM
- CENTRAL CONTROL SYSTEM
- ELECTRICAL CONTROL EQUIPMENT
- MANUAL INPUT

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

NOTES AND REFERENCES

NO.	REVISION	DATE	BY

ORIG. DATE:	10 JAN 1985
DRAWN BY:	MARC ROSS
CHECKED BY:	J. GRANT
DEPT. HEAD:	
PROJ. ENGR:	
ISSUE DATE:	
ISSUED FOR:	

PROJECT TITLE
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

DRAWING TITLE
LOGIC SEQUENCE DIAGRAM
PROCESS OPTION 3

Fenco
FENCO ENGINEERS INC

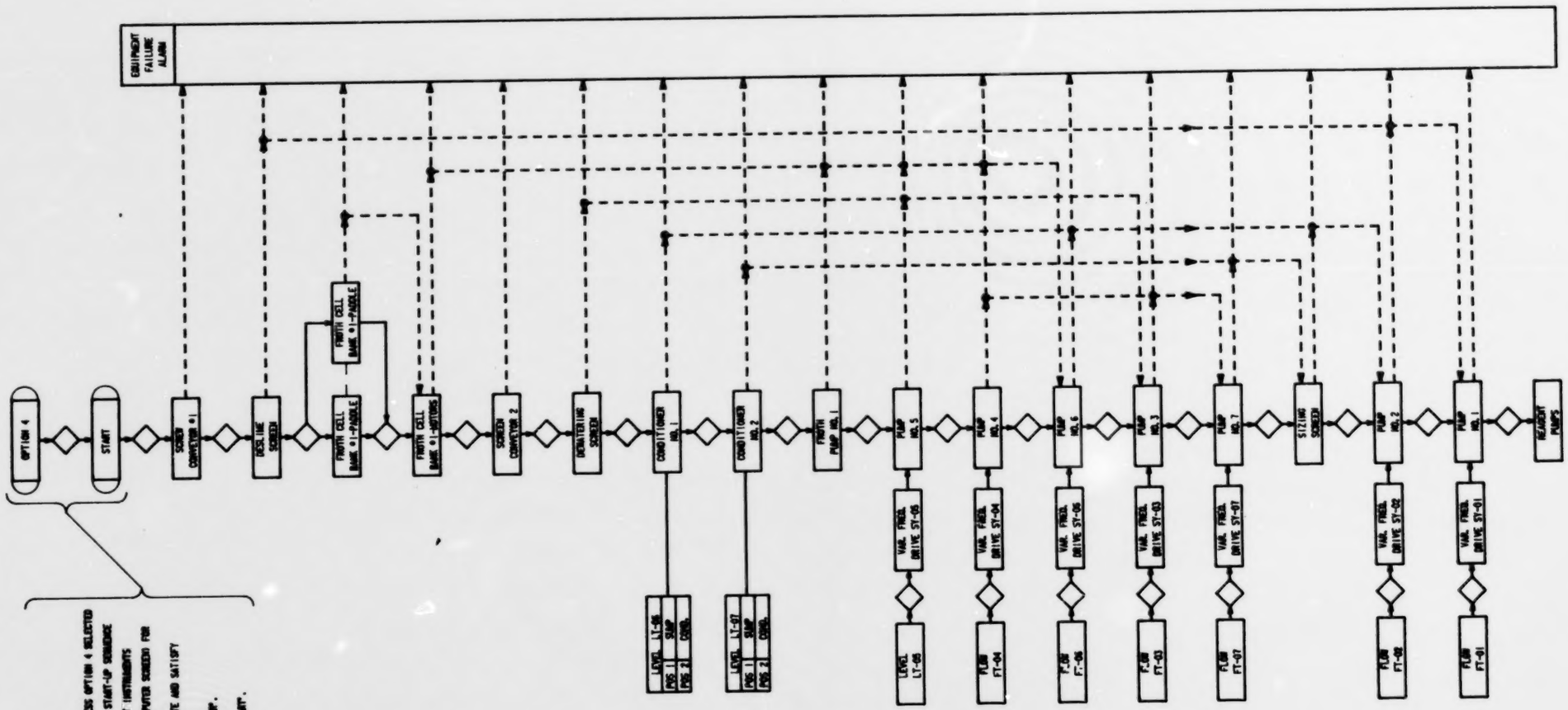
SHEET: NONE

DRAWING NUMBER: 42022-I-13

REV. 0

SUBJECT TO APPROVAL
BEFORE CONSTRUCTION

LEGEND:
- START AND PERMISSIVE
- SHUT DOWN AND ALARM
- CENTRAL CONTROL SYSTEM
- ELECTRICAL CONTROL EQUIPMENT
- MANUAL INPUT



SYSTEM PRE-STARTUP NOTES:

1. LAND COMPUTER
   - TELL COMPUTER PROCESS OPTION 4 SELECTED
   - SETS UP ELECTRICAL START-UP SEQUENCE
   - PRINTS UP PERTINENT INSTRUMENTS
2. CHECK LIST LAUNCHES ON COMPUTER SCREEN FOR PROCESS OPTION 4.
   OPERATOR MUST CONFIRM AND SATISFY THIS CHECK LIST.
3. COMMAND TO "FILL WITH WATER".
4. COMMAND COMPUTER "PLANT START".

NO.	REVISION	DATE	BY

DRN DATE: 10 JAN 1985
DESIGNED BY: MARC ROSS
CHECKED BY: J. GRANT
APPD: [signature]

PROJECT TITLE:
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

DRAWING TITLE:
LOGIC SEQUENCE DIAGRAM
PROCESS OPTION 4

Fenco
FENCO ENGINEERS INC

SCALE: NONE

DRAWING NUMBER: 42022-I-14
REV: 0

LEGEND:
- START AND PERMISSIVE
- SHUT DOWN AND ALARM
- CENTRAL CONTROL SYSTEM
- ELECTRICAL CONTROL EQUIPMENT
- MANUAL INPUT

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

EQUIPMENT FAILURE ALARM

OPTION 5 | START | SLURRY CONVERTOR #1 | SCALPING SCREEN | SLURRY CONVERTOR 2 | DESLIMING SCREEN | FROTH CELL BANK #1-PADDLE | FROTH CELL BANK #1-PADDLE | FROTH CELL BANK #1-ROTORS | CONDITIONER NO. 1 | CONDITIONER NO. 2 | FROTH PUMP NO. 1 | PUMP NO. 5 | PUMP NO. 4 | PUMP NO. 3 | PUMP NO. 7 | SIZING SCREEN | PUMP NO. 6 | PUMP NO. 2 | BOARDOFF PUMPS

LEVEL LT-05 PROG. 1 SUMP PROG. 2 CONTROL

LEVEL LT-07 PROG. 1 SUMP PROG. 2 CONTROL

VAR. FREQ. DRIVE ST-05 | VAR. FREQ. DRIVE ST-04 | VAR. FREQ. DRIVE ST-03 | VAR. FREQ. DRIVE ST-07 | VAR. FREQ. DRIVE ST-06 | VAR. FREQ. DRIVE ST-02

LEVEL LT-05 | FLOW FT-04 | FLOW FT-03 | FLOW FT-07 | FLOW FT-06 | FLOW FT-02

SYSTEM PRE-STARTUP NOTES:

1. LOAD COMPUTER
   - -TELL COMPUTER PROCESS OPTION 5 SELECTED
   - -SETS UP ELECTRICAL START-UP SEQUENCE
   - -POWER UP PERTINENT INSTRUMENTS
2. CHECK LIST (APPEARS ON COMPUTER SCREEN FOR PROCESS OPTION 5)
   OPERATOR MUST EXECUTE AND SATISFY THIS "CHECK LIST".
3. COMMAND TO "FILL WITH WATER".
4. COMMAND COMPUTER "PLANT START".

NO.	REVISION	DATE	BY

ORIG. DATE: 10 JAN 1985
ORIGINATOR: MARC ROSS
CHECKED BY: J. GRANT
DEPT. HEAD:
FINAL APPR.:
ISSUE DATE:
ISSUED FOR:

PROJECT TITLE:
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

DRAWING TITLE:
LOGIC SEQUENCE DIAGRAM
PROCESS OPTION 5

Fenco
FENCO ENGINEERS INC

SHEET: NONE

DRAWING NO.: 12022-I-15

SUBJECT TO APPROVAL
BEFORE CONSTRUCTION

LEGEND:
- START AND PERMISSIVE
- SHUT DOWN AND ALARM
- CENTRAL CONTROL SYSTEM
- ELECTRICAL CONTROL EQUIPMENT
- MANUAL INPUT

SYSTEM PRE-STARTUP NOTES:

1. LOAD COMPUTER
   - -TELL COMPUTER PROCESS OPTION 6 SELECTED
   - -SETS UP ELECTRICAL START-UP SEQUENCE
   - -POWERS UP PORTIGHT INSTRUMENTS
2. CHECK LIST LAMPS ON COMPUTER SCREEN FOR PROCESS OPTION 6.
   OPERATOR MUST OPERATE AND SATISFY THIS CHECK LIST.
3. COMMAND TO "FILL WITH WATER".
4. COMMAND COMPUTER "PLANT START".

NOTES AND REFERENCES

NO.	REVISION	DATE	BY
ORIG. DATE	10 JAN 1985		
DRAWN BY	MARC ROSS		
CHECKED BY	J. GRANT		
APPR.			

ISSUE DATE

ISSUED FOR

PROJECT TITLE
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

DRAWING TITLE
LOGIC SEQUENCE DIAGRAM
PROCESS OPTION 6

Fenco
FENCO ENGINEERS LTD

SHEET
NONE

DRAWING NUMBER
42022-I-18

REV.
0

LEGEND

START AND PERMISSIVE

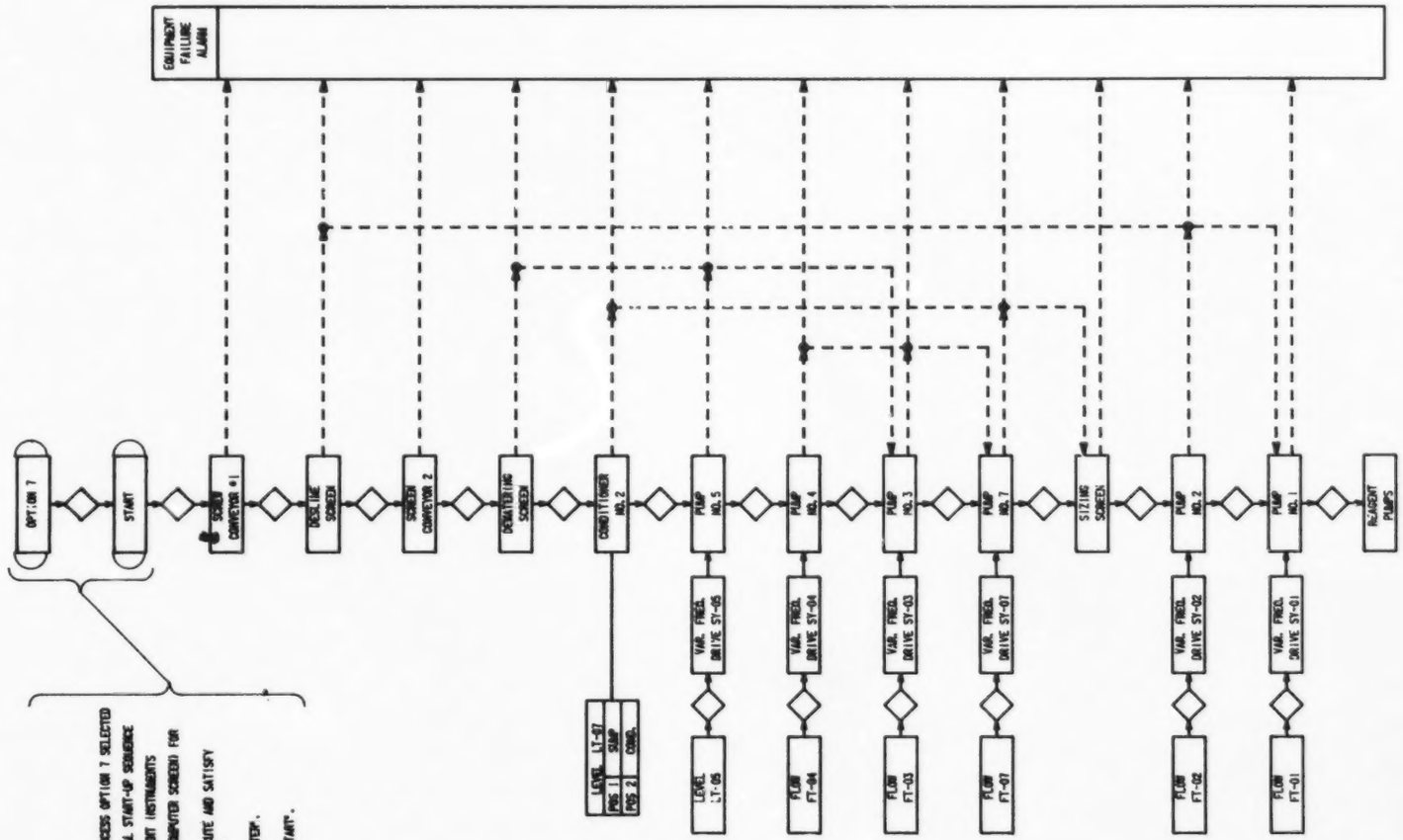
SHUT DOWN AND ALARM

CENTRAL CONTROL SYSTEM

ELECTRICAL CONTROL EQUIPMENT

MANUAL INPUT

SUBJECT TO APPROVAL BEFORE CONSTRUCTION



SYSTEM PRE-STARTUP NOTES:

1. LOAD COMPUTER
   - TELL COMPUTER PROCESS OPTION 7 SELECTED
   - SETS UP ELECTRICAL START-UP SEQUENCE
   - POWERS UP PERTINENT INSTRUMENTS
2. CHECK LIST (APPEARS ON COMPUTER SCREEN) FOR PROCESS OPTION 7, OPERATOR MUST EXECUTE AND SATISFY THIS CHECK LIST.
3. COMMAND TO "FILL WITH WATER".
4. COMMAND COMPUTER "PLANT START".

NOTES AND REFERENCES

NO.	REVISION	DATE	BY

ISSUE DATE: 10 JAN 1985	ORIENTATION:
DESIGNED BY: MARC ROSS	SIZE:
CHECKED BY: J. GRANT	
DEPT. HEAD:	PROJ. MGR: D S Wakeley

ISSUED FOR:

PROJECT TITLE:
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING
MOBILE PLANT

DRAWING TITLE:
LOGIC SEQUENCE DIAGRAM
PROCESS OPTION 7

Fenco
FENCO ENGINEERS INC

SCALE: NONE

DRAWING NUMBER: 42022-I-17

REV: 0

FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION BLOCK DIAGRAM

SYMBOL	DESCRIPTION
PUMP 7A	EQUIPMENT ITEM MOTOR
(2)	SUGGESTED STARTING SEQUENCE
A / B	CONDITIONING MECHANISMS A - CONDITIONING B - NOT CONDITIONING
A	"AND". BOTH CONTACTS WILL INITIATE SHUT DOWN
●	MULTI. ROUTE

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

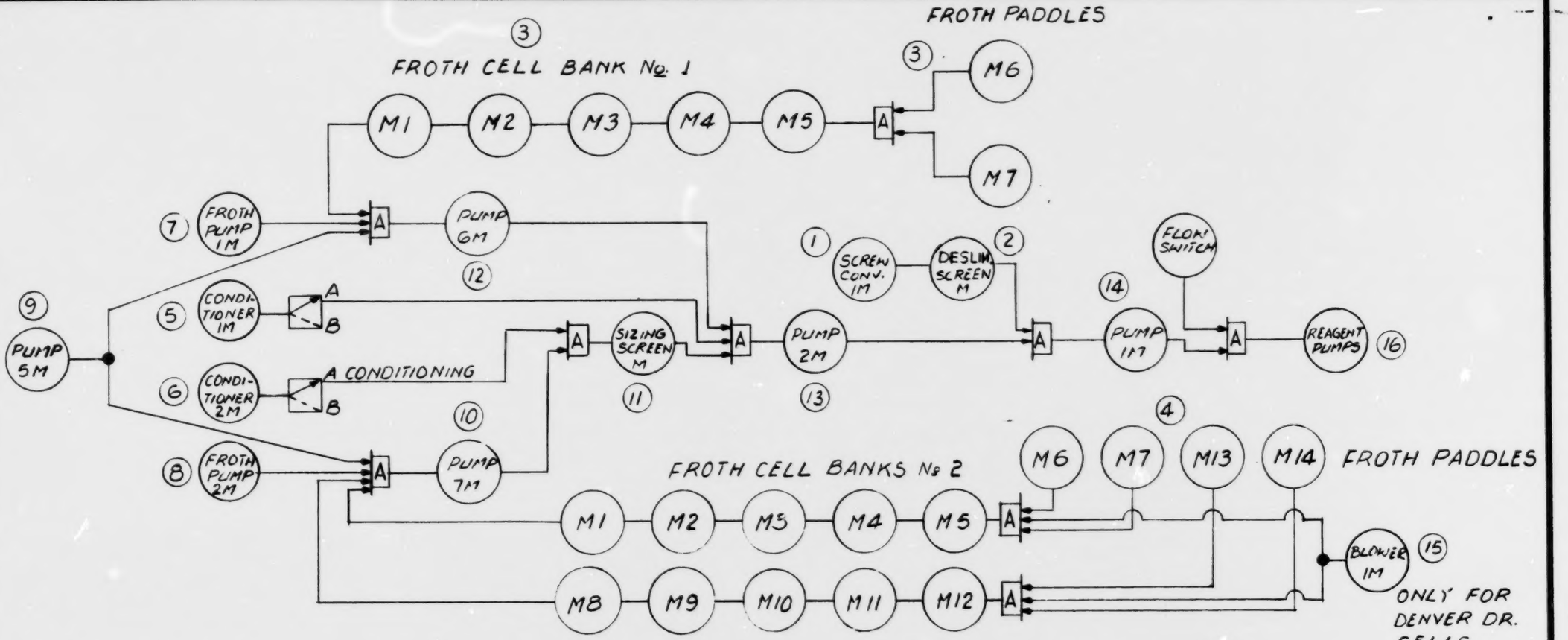
Fenco
Fenco Engineers Inc.

CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

LOGIC BLOCK DIAGRAM
LEGEND

DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MEC.	PROJET	APPROUVÉ
J. J. DATE 84.12.11	DATE	DATE	G.2.4 DATE 22/02/17	DATE	DATE	DATE

ÉCHELLE	No. DESSIN	REV.
—	42022-I-18	0



SUBJECT TO APPROVAL BEFORE CONSTRUCTION

FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION 1 LOGIC DIAGRAM

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

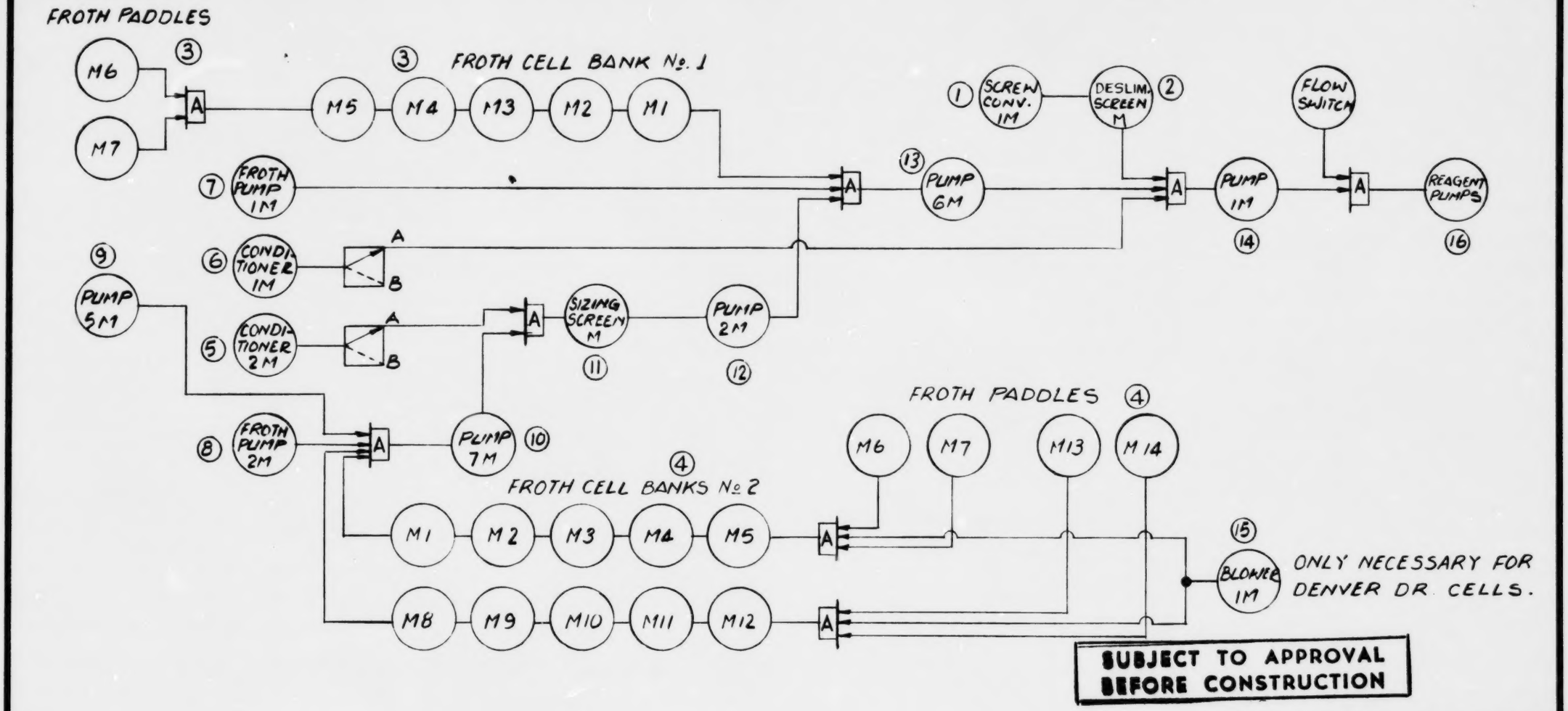
Fenco
Fenco Engineers Inc.

CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

PROCESS OPTION 1
LOGIC DIAGRAM

DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MEC.	PROJET	APPROUVÉ
J.J DATE 84.12.11	DATE	DATE	DATE	DATE	DATE	DATE

ÉCHELLE	No. DESSIN	REV.
—	42022-I-19	0



FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION 2 LOGIC DIAGRAM

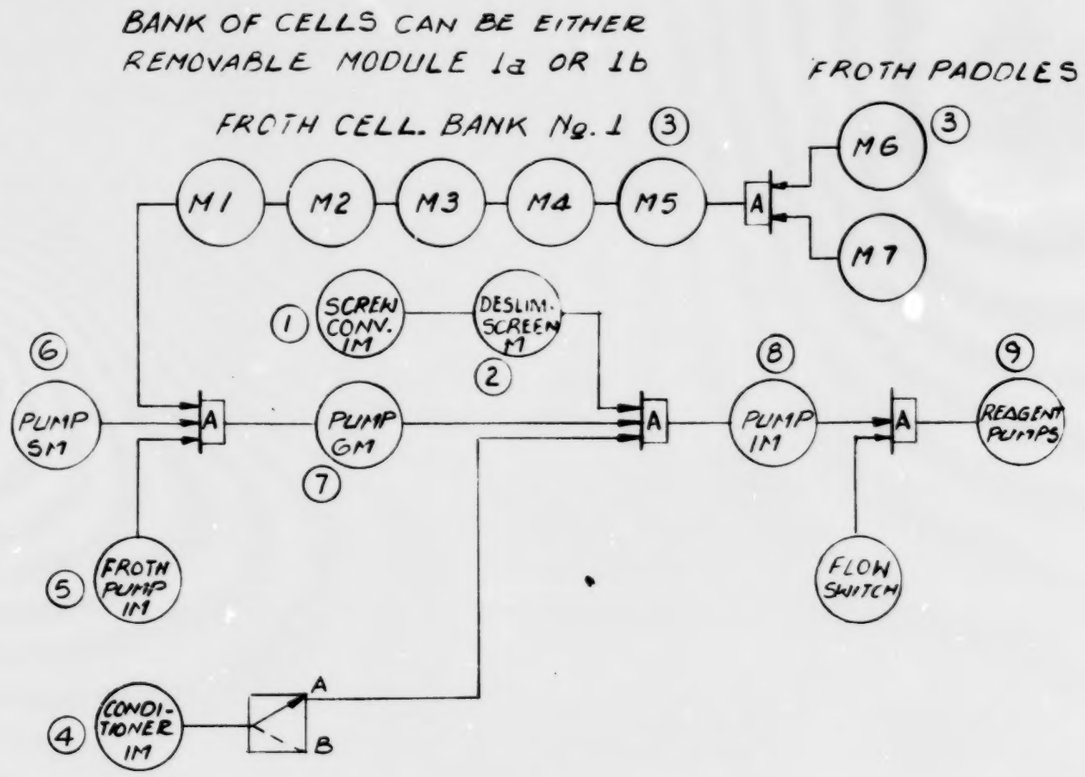
No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

Fenco
Fenco Engineers Inc.

CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

PROCESS OPTION 2 LOGIC DIAGRAM

DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MEC.	PROJET	APPROUVÉ
J.J.	DATE	DATE	DATE	DATE	DATE	DATE
DATE 84.12.12						
ÉCHELLE	No. DESSIN 42022-I-20					REV. 0



FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION 3 LOGIC DIAGRAM

SUBJECT TO APPROVAL BEFORE CONSTRUCTION

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

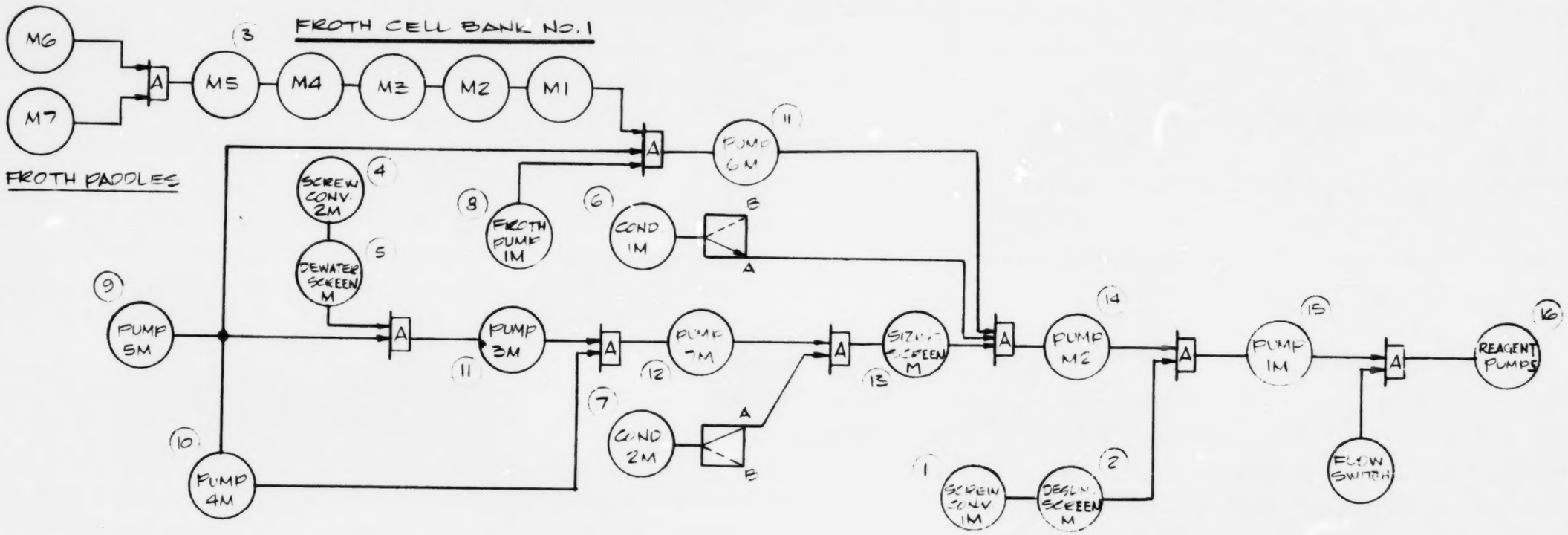
Fenco
Fenco Engineers Inc.

CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

PROCESS OPTION 3
LOGIC DIAGRAM

DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MEC.	PROJET	APPROUVÉ
J.J. DATE 84-12-12	DATE	DATE	DATE	DATE	DATE	DATE

ÉCHELLE	No. DESSIN	REV.
—	42022-I-21	0



SUBJECT TO APPROVAL BEFORE CONSTRUCTION

FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION 4 LOGIC DIAGRAM

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

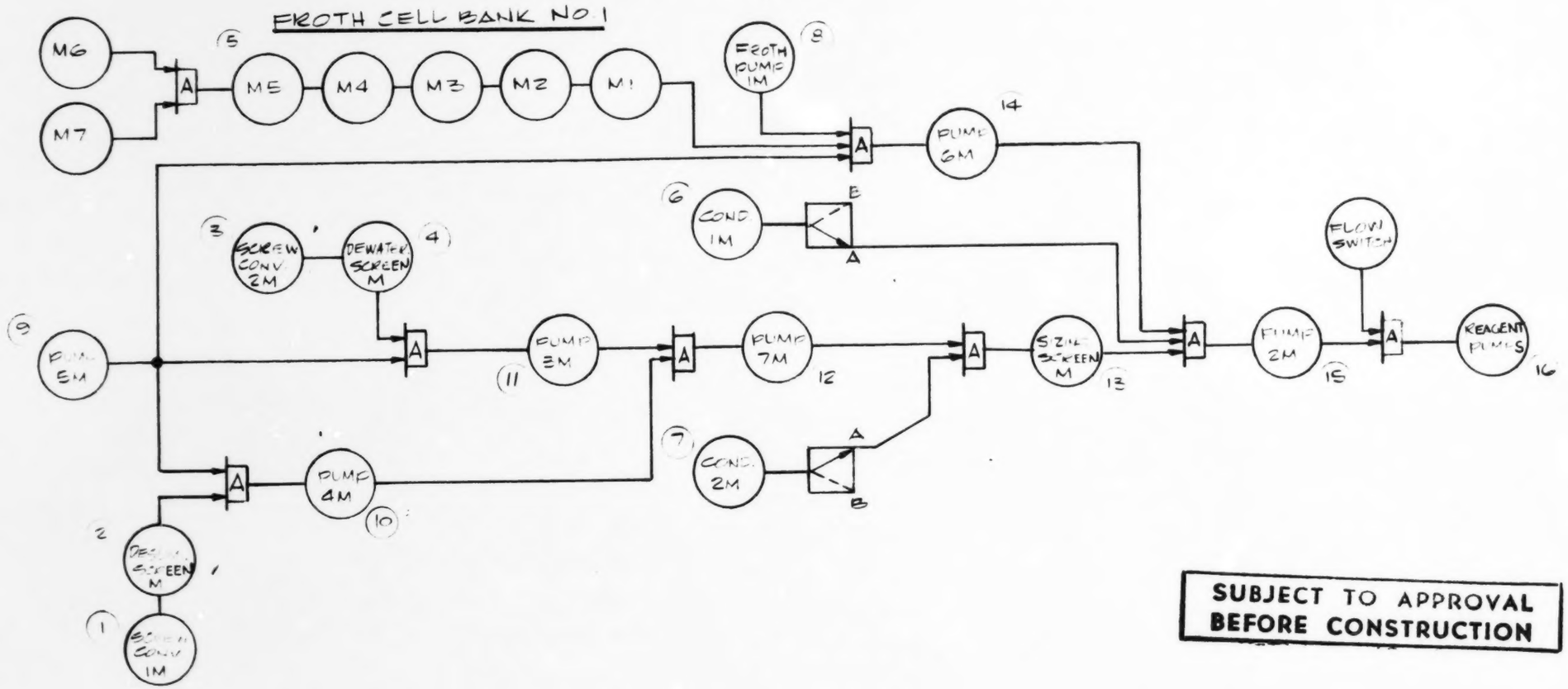
Fenco
Fenco Engineers Inc.

CANMET:
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

PROCESS OPTION 4
LOGIC DIAGRAM

DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MEC.	PROJET	APPROUVÉ
DATE	DATE	DATE	DATE	DATE	DATE	DATE

ÉCHELLE	No. DESSIN	REV.
	42022-I-22	0



FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION 5 LOGIC DIAGRAM

SUBJECT TO APPROVAL
BEFORE CONSTRUCTION

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

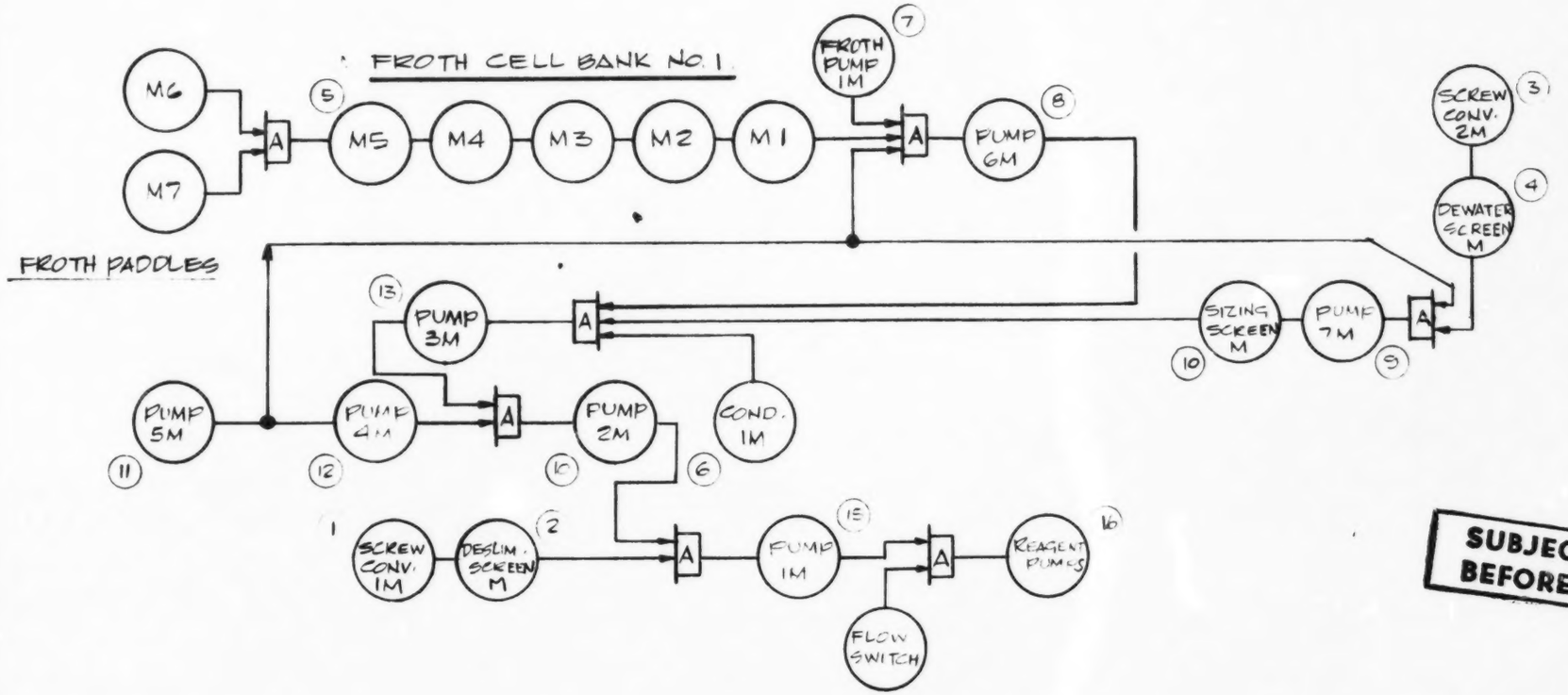
Fenco
Fenco Engineers Inc.

CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

PROCESS OPTION 5
LOGIC DIAGRAM

DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MEC.	PROJET	APPROUVÉ
DATE	DATE	DATE	DATE	DATE	DATE	DATE

ÉCHELLE	No. DESSIN	REV.
	42022-I-23	0



SUBJECT TO APPROVAL BEFORE CONSTRUCTION

FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION 6 LOGIC DIAGRAM

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

Fenco
Fenco Engineers Inc.

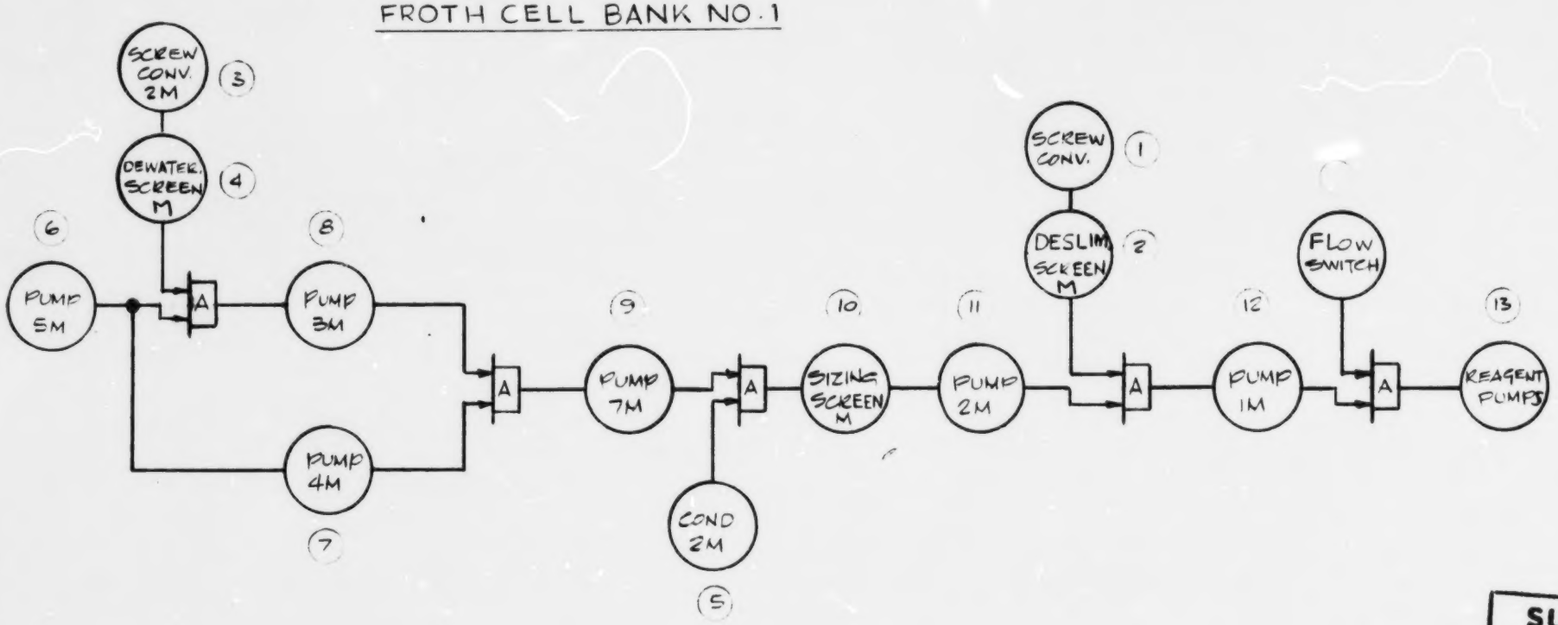
CANMET
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

PROCESS OPTION 6
LOGIC DIAGRAM

DESSINÉ	VÉRIFIÉ	PROCÉDÉ	INSTR.	MEC.	PROJET	APPROUVÉ
DATE	DATE	DATE	DATE	DATE	DATE	DATE

ÉCHELLE	No. DESSIN	REV.
	42022-I-24	0

FROTH CELL BANK NO. 1



SUBJECT TO APPROVAL BEFORE CONSTRUCTION

FINE COAL CLEANING MOBILE PLANT
PROCESS OPTION 7 LOGIC DIAGRAM

No.	RÉVISION	DESSINÉ DATE	VÉRIFIÉ DATE

Fenco
Fenco Engineers Inc.

CANMET:
COAL RESEARCH LABORATORIES
FINE COAL CLEANING MOBILE PLANT

PROCESS OPTION 7
LOGIC DIAGRAM

DESSINÉ DATE	VÉRIFIÉ DATE	PROCÉDÉ DATE	INSTR. DATE	MEC. DATE	PROJET DATE	APPROUVÉ DATE
ÉCHELLE	No. DESSIN	42022-I-25				REV. 0

MAPS NOT

FILMED

CARTES

OMISES